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ANTWERP IN THE SIXTEENTH CENTURY, WITH THE OLD RIVER WALL AND TOWERS, ETC.—Drawn by Mr. H. W. Brewer.

ANTWERP AT THE CLOSE OF THE SIXTEENTH CENTURY.

WHEN arriving at Antwerp, and, for the first time, seeing the fine view of the town from the Scheldt, it must often occur to the visitor to wonder what kind of buildings occupied the "river front" in the Middle Ages before the vast modern hotels, wharves, and warehouses were erected, forming such discordant elements, and contrasting so disagreeably with the fine skyline of ancient church towers and gables. I always thought over this matter until I came across two scarce and very interesting old books, which at once showed me how much had been lost, from a picturesque point of view, by the alterations made during the last two centuries, especially at the close of the eighteenth and commencement of the nineteenth. Down to that period the general aspect of the view had remained pretty much as in earlier times. The French Revolution seems to have created more havoc here than in the land which originated it. If we want to study out what has been lost at Antwerp we should consult such books as "Brabantia Sacra et Profana," or Eitzinger's "De Leone Belgico." The former work is dated 1696, and illustrated by L. Voisterman, Harrewyn, Wenceslaus Hollar, etc., but is very rare, and the copy I possess is the only one I have ever seen. The latter book, though earlier in date, is to be met with in several old collections. It has upon its inner "title page" the curious looking date CIↄ.Iↄ. LXXXIII (1583).

There is a third book called "Les Delices de Brabant," which is not scarce; the illustrations consist of some very inferior copies of "Brabantia Sacra" and a few original drawings of little merit.

Judging from these three works, we can trace the alterations which have been made in the river wall. Originally there were two towers near the cathedral; one was octagonal and crowned by a series of gables and a spirelet, rather lofty. The other, more to the south, was circular in plan, solid, and sturdy, crowned with an extinguisher top. Between these the ancient moat flowed into the Scheldt beneath two arches over which the ramparts were carried. The two towers are indexed in one of the views as "Vercooper's Tooren" and "Backer's Tooren." To the south of the latter extended the "Hüy kay" and the "Bierhof." Against the latter was a large solid gateway, shown in one of Eitzinger's illustrations, and a little beyond it, to the south, stood the great abbey of St. Michel, with its fine church, shown in a view in "Brabantia Sacra." It was a large, lofty, cruciform structure, supported with flying buttresses, with a lantern-crowned tower at the end of the north transept. The cloisters and chapter-house are shown to the south; the latter had three "rose windows" at the eastern end. The principal gate was to the east, and consisted of a large archway flanked on either side by pierced arcaded walls, the openings filled in with ornamental ironwork. There were Doric or Tuscan rusticated columns between the openings, and large statues both on the pediment and the wing walls. Nothing whatever remains of this splendid building. The wall and its towers continued past the west end of the church until it reached the "Casteel," which stood upon the site of the present "Citadel," and was a picturesque group of buildings with a church and numerous windmills. This closed the view to the south. Returning to the cathedral, to the north the second moat ran into the Scheldt a little way beyond the "Vercooper tower;" on its south bank stood the ancient church of St. Walburg, called "De Borch Kircke," with a lofty western tower and slate spire. It has, however, entirely disappeared, with the moat, which was constructed by Henry I., Duke of Brabant, in 1201, to inclose the suburb, which had then grown important. In 1314, however, it became necessary to construct a new moat and fortifications; and in 1543 Charles V. built a new town round the old one, and surrounded it with a moat and walls. The only very important building in it was the Hanseatic Hall, with its lofty tower.

Several later additions have been made, but until a few years back the plan was not materially changed, as may be seen by comparing Eitzinger's plan with that given in Murray's "Handbook" for 1858.

Eitzinger gives in his views drawings of the great Spanish ships which were then at Antwerp, especially one which belonged to the Duke of Alva. This was a fine example of naval architecture of the period, and I have introduced it into the view in the position where it would most probably have floated.—H. W. Brewer, in The Builder.

A CRETAN POMPEII.*

ON the northern shore of the Isthmus of Hierapetra in Crete there has been discovered a Mycenæan town which, with its finds, will throw new light on many vexed questions of prehistoric civilization. This isthmus is the narrowest portion of Crete, and must always have served as a road of communication between the southern and northern seas. It was, therefore, reasonable to suppose that the Mycenæans, who were a seafaring, trading people, had utilized the natural advantages of this region. And yet, with the exception of a few gems (a class of objects which have little value in marking a site because they are so easily carried from place to place), no Mycenæan finds had been made there; and Lucio Mariani, in his notes upon this district, confines himself to rather vague mention of two places, as possibly prehistoric.

In his quest of early seal-stones, Mr. Arthur Evans, in the summer of 1899, came upon a tomb of the Geometric period in the mountains that wall the isthmus to the east. Following up a clew given us by him, Miss Patten, of Boston, and I, in May and June, 1900, worked on the heights above Kavousi, excavating houses and tombs of Geometric times. The results of these excavations were reported to the Archæological Institute of America, at its annual meeting in Philadelphia, December 22, 1900, and have been published in the last number of the Journal of the Institute. They excited some interest, as any light on this obscure epoch was welcome, but no one was tempted to pursue inquiries in this field; Cretan Geometric finds being held in light esteem in comparison with the relics of the island's greater days, when Minos ruled the sea and built the rich palace that is being uncovered by Mr. Evans at Knossos.

Early in May, Miss B. E. Wheeler, of Concord, and I took out government permission to excavate for the American Exploration Society of Philadelphia in the neighborhood of Kavousi. Our hope for a successful campaign was based on a few fragments of Mycenæan pottery found in Kavousi plain during the first day's digging last year, before work on the hills had begun. In the immediate vicinity of the place where they were found diligent search during two successive seasons has failed to reveal any other trace of prehistoric habitation. Nevertheless, these fragments led indirectly to our finding "the most perfect example yet discovered of a small Mycenæan town." This town lies on a hill called Gournia, within the deme of Kavousi, but four miles distant from the village of that name. The site crosses a much-traveled road that leads from Heracleion to Sitia. Covered with stones and overgrown with wild carob trees, the low hill, although in form and in proximity to the sea an exact type of a Mycenæan acropolis, had escaped the notice of traveling archæologists; and to the peasants of Basilike, a neighboring village, is due the honor of first observing traces of old walls and fragments of ancient pottery. Trial pits were dug on May 20, and six weeks' work with a force of about one hundred laborers revealed a town which has been aptly called by visiting scholars a Mycenæan Pompeii.

From the sea a paved road leads to the foot of the hill, a distance of about a quarter of a mile, and there divides into the east and west roads, which, climbing the slope, conduct the traveler to the palace of the Prince. Right and left open side streets and houses. The roads are about five feet wide, furnished with terra cotta gutters, and well paved with stones, which are worn by the tread of generations that vanished from the earth three thousand years ago. In the steeper parts of the hill the roads form flights of steps, and one or two houses are provided with private stairways leading to them. The houses are built with rubble foundations and upper walls of brick; in the more important parts of the palace, ashlar masonry takes the place of rubble. Several of the houses have walls standing to a height of six or eight feet. Plaster is used extensively for the facing of walls and door jambs. There are many proofs of the existence of a second story, which, in certain cases determined by the formation of the hill, is entered from an upper road. Twelve houses have been excavated, the majority of which have eight rooms or more. Of the palace fourteen rooms, mostly magazines of the Knossos type, have been uncovered, as well as a terrace, court, and column base and aula evidently belonging to a portal. In the center of the town, and approached by a road of its own, lies a shrine, not imposing as a piece of architecture, but of unique importance as being the first Mycenæan shrine discovered intact. It is a small quadrangular building, which, lying near the top of the hill, has suffered much from the forces of nature. A wild carob tree growing within its bounds had partly destroyed and partly saved its contents. Of these the most noteworthy are a low terra cotta table with three legs, which possibly served as an altar; cultus vases with symbols of Mycenæan worship; the disk, "consecrated horns of the altar," and double-headed ax of Zeus; and a terra cotta idol of the "glaukopis Athene" type, with snakes as attribute.

The life of the people is revealed not only in the palace, shrine, and houses, but in the objects of pottery, stone, and bronze which the site has yielded. Of these may be mentioned stone basins, perhaps used as tables of offering, and stone vases delicately carved; pottery, remarkable for the variety of design and of decoration, which includes all the well-known Mycenæan motives of sea plants and sea animals, together with many unfamiliar types; stone and bronze tools of every description, as well as bronze spear points, swords, daggers, knives, and ornaments. A bronze saw, 45 centimeters long, has attracted much attention among scholars. On five vases we find painted the ax of *Ζευς Δαβρανδιος*—a confirmation, if such were needed, of Mr. Evans's opinion as to the sanctity of this symbol. The double ax is also carved on one of the blocks of the palace, as at Knossos and Phæstos. No trace of Mr. Evan's linear or pictographic script has been found at Gournia, but we have Mycenæan gems of exquisite workmanship, and ancient seal impressions in clay from beautiful originals not yet discovered. The types represented are the octopus, water-fowl, lion, etc. From the absence of fortifications we infer that the people of Gournia were peaceful, and from abundant evidence that cannot be given here, we know them to have been engaged in fishing, trading, and other industries. The place appears to have been sacked and burned, possibly by the very mountaineers whose homes were investigated by us last year.

Such are the satisfactory results of this year's work. The importance of the excavations at Gournia has been already recognized by archæologists of other lands, as will be seen by reference to Mr. D. G. Hogarth's article in The London Times of August 10. The work was made possible by the generosity of Mr. Calvin Wells, of Pittsburg, and Mr. Charles H. Cramp, of Philadelphia. There is abundant opportunity to learn more of Mycenæan provincial life by continuing the excavations at Gournia and at other promising points on the isthmus noted during this year's campaign.

* Harriet A. Boyd, Smith College, in The Nation.

THE CONSTELLATION ORION.

MR. E. W. MAUNDER, F. R. A. S., in a recent number of Knowledge, writes, under the heading "Constellation Studies": "The long nights of winter are the time when the heavenly hosts gather in their most resplendent squadrons. Sirius, by far the brightest of all the fixed stars, reaches the meridian at midnight of New Year's Day. Orion, the most splendid single constellation, is crossing from 10:30 to 11:10, the same night. Procyon, the Lesser Dog star, follows Sirius in its southing by about forty minutes. Both the Authorized and the Revised Versions of the Bible refer the Kesil of Job xxxviii., 31, to this constellation. There is much probability that the rendering of the Revised Version for the other two constellation names mentioned in this text, Aish and Kimah, 'the Bear' and 'Pleiades,' is quite correct, but there is more uncertainty in the present identification. Kesil means 'impious, mad, rebellious,' and as such is traditionally supposed to refer to Nimrod, 'the mighty hunter before the Lord,' supposed to be the first great conqueror, and the first to set up a tyranny based upon military power. One difficulty in rendering Kesil by Orion is that the same word occurs in the plural in Isaiah xiii., 10, where the word is translated 'constellations.' If Kesil, therefore, really refers to Orion we must suppose that in this passage the most glorious constellation of the sky is put for constellations in general. The context, however, would rather lead to the idea that we should look for a winter constellation to correspond to Kesil; for just as 'the sweet influences of the Pleiades' evidently refer to the revival of nature in the spring, so 'the bands of Orion' may be naturally supposed to point to its imprisonment by the cold of winter. If Nimrod be really the original Orion, there was an unsuspected appropriateness in the sycophantish proposal of the University of Leipzig to give the center stars of the group the name of Napoleon, the most modern example of the same mad ambition."

CURRENT QUESTIONS IN ANTHROPOLOGY.*

No idea is more firmly fixed in the mind of the average man than that of monogenesis, i. e., the idea that all mankind sprang from a single pair, and hence came up in a single center. Nor is the prevalence of the idea surprising; engendered by the associations of family, fostered by honorable regard for worthy ancestors, and nourished by tradition, it grows into a natural intuition; and when intensified by the teachings of biology (whence most modern thinkers derive early lessons), it readily matures in a postulate so simple and so strong that few anthropologists take the trouble to question its validity. Yet once the question is raised, the postulate is seen to be gratuitous; in the present state of knowledge it may not be either affirmed or denied with confidence; but it must be recognized that the intuitive idea of monogenesis is not supported by a single observation in the domain of anthropology, and is opposed by the great body of observations on human development. The first corollary of the monogenetic postulate is that mankind differentiate—that they differentiated in the beginning, that they are differentiating now, or that they differentiated at some intermediate stage, one or all; in any event, that the course of human development is one of progressive differentiation. Of course, if the postulate were a direct inference or a generalization, this mode of statement would be reversed; in that case it would be necessary to say that certain observed facts of differentiation lead to an inference of differentiation in general, and point to a law of monogenesis; but it cannot be too strongly emphasized that the notion of monogenesis in the human realm does not represent observation, generalization, inference or other inductive procedure from fact to interpretation—it is a pure assumption, imported into anthropology from other realms of thought, introduced as a full-grown foundling, and ever at war with the legitimate offspring of the science of man.

The great fact attested by all observation on human development, and susceptible of verification in every province and people, is that mankind are not differentiating in either physical or psychical aspects, but are converging, integrating, blending, unifying, both as organisms and as superorganic groups. The population of the world is steadily increasing, but the number of races is not; while the number of distinct peoples is progressively decreasing and the racial boundaries are slowly but surely melting away. This present condition is in accord with the past so far as history runs; races have not come up, tribes have not multiplied, but distinct peoples have coalesced, dialects and languages have blent into common tongues, throughout the known world—indeed, the processes of integration have been so characteristic of human progress throughout the historical period that it is now possible to enounce, if not to establish, the proposition that peoples are pre-eminent in proportion to the complexity of their blood and culture. These salient facts of the present and of the recorded past fall naturally into a generalization of integral or convergent development, which in turn points toward a hypothesis of polygenesis. The major indications are supported by minor ones too numerous for easy counting; and the burden of the testimony is amply sufficient to compel the open-minded anthropologist to tolerate the polygenetic hypothesis, if not to accept it as a working platform alternative with that of the monogenesis so long yet so gratuitously assumed.

Several students, like Keane in recent publications, have, indeed, held that the black, brown, yellow and white races cannot have sprung from common parents; yet it may be questioned whether even this position is not merely a stepping-stone toward a more general view of humanization beginning with many varieties of the unknown prototype in different regions, coming up through the multifarious tribes of scientific record, and approaching the dominant types of to-day. Certain it is that when a race or congeries of tribes measurably similar in physical features—e. g., the Amerinds—are considered with respect to the intertribal relations established by record and tradition, their history is found to be one of coalescence, through the growth of stronger groups and the assimilation or elimination of weaker, through the interchange (whether inimical or amical) of artifacts and industrial processes, through more or less frequent intermarriage, through the giving and taking of linguistic elements, through the interchange of custom, faith, ceremony, law and other factors of culture which react on mental and bodily exercise and thus shape develop-

* Abstract of address before Section H, Denver Meeting, American Association for the Advancement of Science.—From Science.

ment; the interchange and coalescence may be slow and incomplete, as between the Seri and Guayaqui tribes and their respective neighbors, or rapid and comprehensive, as in the Iroquois and Dakota confederacies, yet it is ever-present, and when the lines of development are traced backward they are invariably found to diverge more or less widely and point toward more or less distinctive origins.

What is true of the Amerind tribes in this respect is even more conspicuously true of the African tribes, ranging from the pygmy Akka to the gigantic Zulu and other widely diverse physical and cultural types; most of these tribes, too, have been observed in actual coalescence with their neighbors, while not a single satisfactory indication of differentiation or increasing distinctiveness has ever been detected; so that here, too, the developmental lines traced backward are found to diverge and multiply up to the very verge of the unknown—the prehistoric, or at least the scriptless, past. And what is true of America and Africa is more or less conspicuously true of other continents and other peoples; everywhere the developmental lines converge forward and diverge backward, just as the lines of biotic development diverge forward and converge backward. How this discrepancy is to be removed is a question whose importance increases with every advance in the science of anthropology.

It seems not too much to say that the leading question before the anthropologist of to-day is that relating to the trend of human development and its bearing on the alternatives (postulate and inference, respectively) of monogenesis and polygenesis; for it is easy to see that most of the other questions are affected by this primary one. The definition of race, the discussion of human antiquity and various civil problems of the day are all involved; and while it is too much to hope for general agreement concerning the fundamental question at any early day, it is none the less desirable to note the trend of multiplying facts and observe their steady set toward the inductive hypothesis of polygenesis rather than toward the deductive assumption of monogenesis. W. J. McGee.

Bureau of American Ethnology.

A PLEA FOR GREATER SIMPLICITY IN THE LANGUAGE OF SCIENCE.*

By T. A. Rickard, Denver.

Scientific ideas are with difficulty soluble in human speech. Man, in his contemplation of the flux of phenomena at work all about him, is embarrassed by the want of a vehicle of thought adequate for expression, as a child whose stammering accents do not permit him to tell his mother the new ideas which suddenly crowd upon him when he meets with something alien to his experience.

Our knowledge of the mechanism of nature has been undergoing a process of growth, much of which has been sudden. It is not surprising, therefore, that the incompletely formed ideas of science should become translated into clumsy language and that inexact thinking should be evidenced by vagueness of expression. This inexactness is often veiled by the liberal use of sonorous Greek-Latin words.

Barrie has remarked that in this age, the man of science appears to be the only one who has anything to say—and the only one who does not know how to say it. It is far otherwise in politics, an occupation which numbers among its followers a great many persons who have the ability for speaking far beyond anything worth the saying that they have to say. Nor is it so in the arts, the high priests of which, according to Huxley, have "the power of expression so cultivated that their sensual caterwauling may be almost mistaken for the music of the spheres." In science there is a language as of coded telegrams, by the use of which a limited amount of information is conveyed through the medium of six-syllabled words. Even when not thus overburdened with technical terms it is too often the case that scientific conceptions are conveyed in a raw and unpalatable form, mere indigestible chunks of knowledge, as it were, which are apt to provoke mental dyspepsia. Why, I ask, should the standard English prose of the day be a chastened art and the writing of science, in a great scientific era, merely an unkempt dressing of splendid ideas? The luminous expositions of Huxley, the occasional irradiating imagery of Tyndall, the manly speech of Le Conte and of a very few others all serve simply to emphasize the fact that the literature of scientific research as a whole is characterized by a flat and ungainly style, which renders it distasteful to all but those who have a great hunger for learning.

To criticism of this sort the professional scientist can reply that he addresses himself not to the public at large, but to those who are themselves engaged in similar research, and he may be prompted to add to this the further statement that he cannot pitch the tone of his teachings so as to reach the unsensitive intelligence of persons who lack a technical education. Furthermore, he will claim that he cannot do without the use of the terms to which objection is made. However, in condemning the needless employment of bombastic words of classical origin, in place of plain English, I do not wish to be understood as attacking all technical terms. They are a necessary evil. Some of them are instruments of precision invented to cover particular scientific ideas. Old words have associations which sometimes unfit them to express new conceptions, and therefore fresh words are coined. The complaint lodged against the pompous ungainly wordiness of a large part of the scientific writing of the day is that it is an obstacle to the spread of knowledge.

Let us consider the subject as it is thus presented. In the first place, does the excessive use of technical terms impede the advancement of science? I think it does. It kills the grace and purity of the literature by means of which the discoveries of science are made known. Ruskin, himself a most accurate observer of nature and also a geologist, said that he was stopped from pursuing his studies "by the quite frightful inaccuracy of the scientific people's terms, which is the consequence of their always trying to write mixed Latin and English, so losing the grace of the one and the sense of the other." But grace of diction is not needed, it may well be said; that is true, and it is also true that a clear, forceful, unadorned mode of expression is more difficult of attainment and more desirable in the teaching of science than either grace or fluency of diction. One must not, as Huxley himself remarks, "varnish the fair face of Truth with that pestilent cosmetic, rhetoric," and Huxley most assuredly solved the problem of how to avoid rhetorical cosmetics and yet convey deep reasoning on the most complex of subjects in addresses which are not only as clear as a trout stream, but are also brightened by warm touches of humanity, keen wit and the glow of his own courageous manhood.

The next aspect of the inquiry is whether the language of science, apart from the view of mere grace of style in literature, is not likely, in its present everyday form, to delay the advance of knowledge by its very obscurity. Leaving the reader's feelings out of the argument, for the present, it seems obvious that the whole purpose of science, namely, the search after truth, which is best advanced by accuracy of observation and exactness of statement, is hindered by a phraseology which sometimes means very much, but oftener means very little, and, on the whole, is most serviceable when required as a cloak for ignorance. To distinguish between what we know and what we think we know, to comprehend accurately the little that we do know, surely these are the foundations of scientific progress. If a man knows what a thing really is, he can say so, describing it, for example, as being black and white; if he does not know, he masks his ignorance by stating in a few Greek or Latin terms that it partakes of the general quality of grayness. Writers get into the habit of using words that they do not clearly understand themselves and which, as a consequence, must fail in conveying an exact meaning to their readers. Many persons who possess only the smattering of a subject are apt to splash all over it with words of learned sound which are more quickly acquired, of course, than the reality of knowledge. Huxley said that if a man does really know his subject "he will be able to speak of it in an easy language and with the completeness of conviction with which he talks of an ordinary every-day matter. If he does not, he will be afraid to wander beyond the limits of the technical phraseology which he has got up." If any scientific writer should complain that simplicity of speech is impracticable in dealing with essentially technical subjects, I refer him to the course of lectures delivered by Huxley to working men, lectures which conveyed original investigations of the greatest importance in language which was as easily understood by his audience as it was accurate when regarded from a purely professional standpoint.

Science has been well defined as "organized common sense," let us then express its findings in something better than a mere jargon of speech, and avoid that stupidity which Samuel Johnson, himself an arch-sinner in this respect, has fitly described as "the immense pomposity of sesquipedalian verbiage."

Vagueness of language produces looseness of knowledge in the teacher as well as the pupil. Examples of this form of error are easy to find. The word "dynamic" has a distinct meaning in physics, but it is ordinarily employed in the loosest possible manner in geological literature. Thus, the origin of a perplexing ore deposit was recently imputed to the effects produced by the "dynamic power" which had shattered a certain mountain. "Dynamic" is of Greek derivation and means powerful, therefore a "powerful power" had done this thing, but in physics the word is used in the sense of active as opposed to "static" or stationary, and it implies motion resulting from the application of force. In the case quoted, and in many similar instances, the word "agency" or "activity" would serve to interpret the hazy idea of the writer, and there is every reason to infer, from the context, that he substituted the term "dynamic power" merely as a frippery of speech. It is much easier to talk grandiloquently about a "dynamic power" which perpetrates unutterable things and reconstructs creation in the twinkling of an eye than it is to make a careful study of a region, trace its structural lines and decipher the relations of a complicated series of faults. When this has been done and a writer uses comprehensive language to summarize activities which he has expressly defined and described, then, indeed, he has given a meaning to such words which warrants him in the use of them.

Among geological names there is that comfortable word "metasomatosis" and its offspring of "metasomatic interchange," "metasomatic action," "metasomatic origin," etc., etc. To a few who employ the term to express a particular manner in which rocks undergo change, it is a convenient word for a definite idea, but for the greater number of writers on geological subjects it is a wordy cloud, a nebular phrase, which politely covers the haziness of their knowledge concerning a certain phenomenon. When you don't know what a thing is, call it a "phenomenon." Instances of mere vulgarity of scientific language are too numerous to mention. "Auriferous" and "argentiferous" are ugly words. They are unnecessary ones also. The other day a metallurgical specialist spoke of "auriferous amalgamation" as though any process in which mercury is used could be gold-bearing unless it was part of the program that somebody should add particles of gold to the ore under treatment. A mining engineer, of the kind known to the press as an expert, described a famous lode as traversing "on the one hand a feldspathic tufaceous rock" and "on the other hand a metamorphic matrix of a somewhat argillo-arenaceous composition." This is scientific nonsense, the mere travesty of speech. To those who care to dissect the terms used, it is easily seen that the writer of them could make nothing out of the rocks he had examined save the fact that they were decomposed and that the rock which he described last might have been almost anything for all he said of it, for his description, when translated, means literally a changed matter of a somewhat clayey-sandy composition, which, in Anglo-Saxon, is m-u-d. The "somewhat" is the one useful word in the sentence. Such language may be described in the terms of mineralogy as metamorphosed English pseudomorphic after blatherskite.

Next consider the position of the reader. It is scarcely necessary at this date to plead for the cause of technical education and the generous bestowal of the very best that there is of scientific knowledge. The great philosophers of that New Reformation which marked the era of the publication of "The Origin of Species," have given most freely to all men of their wealth of learning and research. When these have given so much we might well be less niggardly with our small change and cease the practice of distributing, not good wholesome intellectual bread, but the mere stones of knowledge, the hard fossils of what were once stimulating thoughts. Among certain scientific men there is a feeling that scientists should address themselves only to fellow scientists and that to become an expositor to the unlearned is to lose caste among the learned. There are not many, however, who dare confess to such a creed, although their actions may occasionally endorse it. On the whole, modern science is nothing if not catholic in its generosity. "To promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life" was the avowed purpose of the greatest of the philosophers of the Victorian era.

There are those who are full of a similar good-will, but they fail in giving effect to it because they are unable to use language which can be widely understood. In its very infancy geology was nearly choked with big words, for Lyell, the father of modern geology, said, seventy wears ago, that the study of it was "very easy, when put into plainer language than scientific writers choose often unnecessarily to employ." At this day even the publications of the Geological Surveys of the United States and the Australian colonies, for example, are occasionally restricted in usefulness by erring in this respect, and as I yield to none in my appreciation of the splendid service done to geology and to mining by these surveys, I trust my criticism will be accepted in the thoroughly friendly spirit with which it is offered. It seems to me that one might almost say that certain of these extremely valuable publications are "badly" prepared because they seem to overlook the fact that they are, of course, intended to aid the mining community in the first place and the public, whether lay or scientific, only secondarily. From a wide experience among those engaged in mining, I can testify that a large part of the literature thus prepared is useless to them, and that no one regrets it more deeply than they because there is a marked tendency among this class of workers to appreciate the assistance which science can give. Take, for example, a sentence like the following, extracted from one of the recent reports of the United States Geological Survey: "The ore forms a series of imbricating lenses, or a stringer lead, in the slates, the quartz conforming as a rule to the carunculated schistose structures, though occasionally breaking across laminæ, and sometimes the slate is so broken as to form a reticulated deposit." This was written by one of our foremost geologists and, when translated, the sentence is found to convey a useful fact, but is it likely to be clear to anyone but a traveling dictionary? A thoroughly literary man might know the exact meaning of the two or three very unusual words which are employed in this statement, but the question is, will it be of any use whatever even to a fairly educated miner, or be understood by those who pay for the preparation of such literature, namely, the taxpayers? An example of another kind is afforded by a Tasmanian geologist who recently described certain ores as due to "the effects of a reduction in temperature of the hitherto liquefied hydroplutonic solutions, and their consequent regular precipitations." These solutions, it is further stated, presumably for the guidance of those who wield the pick, "ascended in the form of metallic superheated vapors which combined eventually with ebullient steam to form other aqueous solutions causing geyser-like discharges at the surface, aided by subterranean and irrepressible pressure." At the same time certain "dynamical forces" were very busy indeed and "eventuated in the opening of fissures"—of which one can only regret that they did not swallow up the author as Nathan and Abiram were once engulfed in the sight of all Israel.

It will be well to contrast these two examples of exuberant verbosity because the first befogs the statement of a scientific observation of value, made by an able man, while the second cloaks the ignorance of a charlatan, who masquerades his nonsense in the trappings of wisdom. Here you have an illustration of the harmfulness of this kind of language, which obscures truth and falseness alike, to the degradation of science and the total confusion of those of the unlearned who are searching after information.

In all seriousness, is it too much to ask that such technical terms as are considered essential shall not be used carelessly, and that in the publications intended for an untechnical public, as are most government reports, an effort be made to avoid them and, where unavoidable, those which are least likely to be understood shall be translated in footnotes. Even as regards the transactions of scientific societies, I believe that those of us who are active members have little to lose and much to gain by confining the use of our clumsy terminology to cover ideas which we cannot otherwise express. By doing so we shall contribute, I earnestly believe, to that advancement of science which we all have at heart.

* Read before the Denver Meeting of the American Association for the Advancement of Science, August, 1901.

ON THE STRUCTURE AND ORIGIN OF JET.*

The hard jet of Whitby appears to have been used in Britain in pre-Roman days; it is alluded to by Caedmon, and mentioned in 1350 in the Records of St. Hilda's Abbey. It was formerly extensively mined in the cliffs of the Yorkshire coast, near Whitby and elsewhere; in Eskdale, Danby Dale, and in several of the dales that intersect the East Yorkshire moorlands. The hard jet occurs in the *Ammonites serpentinus* zone of the Upper Lias, frequently in the form of flattened masses or layers, which in rare cases have been found to reach a length of 6 feet. Parkinson, in his "Organic Remains of a Former World"

* Abstract of a paper read before Section K of the British Association at Glasgow, by A. C. Seward, F.R.S.

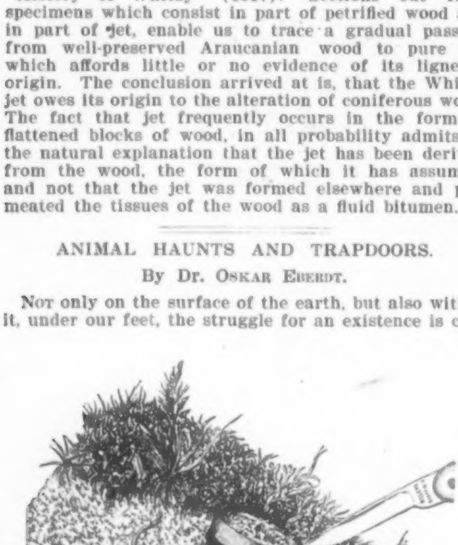
(1811) speaks of jet, in some cases, as pure bitumenized vegetable matter, and the majority of writers regard it as having been found as a product of alteration of plant tissues. On the other hand, it has been described (Tate and Blake, "The Yorkshire Lias," 1876) as "the result of the segregation of the bitumen" in the intervals of the jet shales, which has sometimes formed pseudomorphs after blocks of wood. The author has recently examined several sections of Yorkshire jet in the British Museum, which he believes demonstrate the origin of this substance from the alteration of coniferous wood, and, in part at least, of wood of the Araucanian type.

The occurrence of specimens of silicified wood having a covering layer of jet, is spoken of by Young, in his "History of Whitby" (1817). Sections cut from specimens which consist in part of petrified wood and in part of jet, enable us to trace a gradual passage from well-preserved Araucanian wood to pure jet, which affords little or no evidence of its ligneous origin. The conclusion arrived at is, that the Whitby jet owes its origin to the alteration of coniferous wood. The fact that jet frequently occurs in the form of flattened blocks of wood, in all probability admits of the natural explanation that the jet has been derived from the wood, the form of which it has assumed, and not that the jet was formed elsewhere and permeated the tissues of the wood as a fluid bitumen.

ANIMAL HAUNTS AND TRAPDOORS.

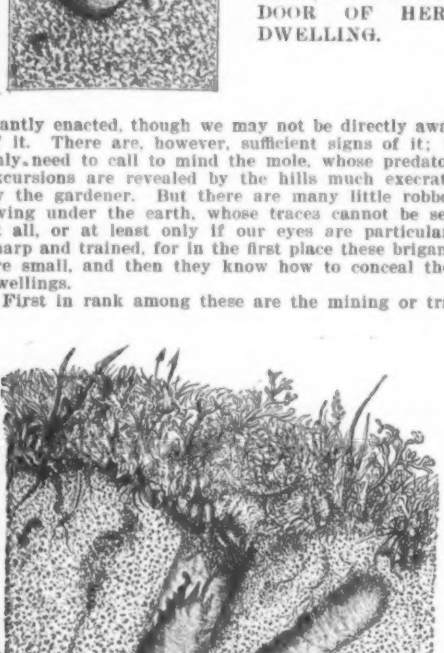
By Dr. Oskar Eberdt.

Not only on the surface of the earth, but also within it, under our feet, the struggle for an existence is constantly enacted, though we may not be directly aware of it. There are, however, sufficient signs of it; we only need to call to mind the mole, whose predatory excursions are revealed by the hills much execrated by the gardener. But there are many little robbers living under the earth, whose traces cannot be seen at all, or at least only if our eyes are particularly sharp and trained, for in the first place these brigands are small, and then they know how to conceal their dwellings.



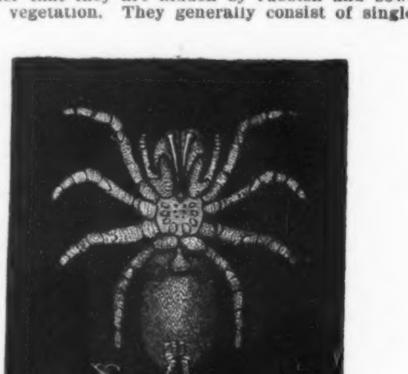
MINING SPIDER ENDEAVORING TO BLOCK THE TRAP DOOR OF HER DWELLING.

First in rank among these are the mining or trapdoor spiders. In Europe they have been observed in the vicinity of Paris, and another variety, called *Atypus*, which, however, does not close its burrow with a trapdoor, occurs in England. A representative of this variety, lying on its back, hence seen from below, is shown in our illustration. We recognize the eight strong legs and the thick body with the spinning apparatus at the hind end. The head is very large in proportion to the rest of the body. This is necessary, for with its aid and that of the jaw feelers, which are armed with a kind of sharp mouth, as well as of the feet, that are toothed like a comb, the animal digs its underground haunt.

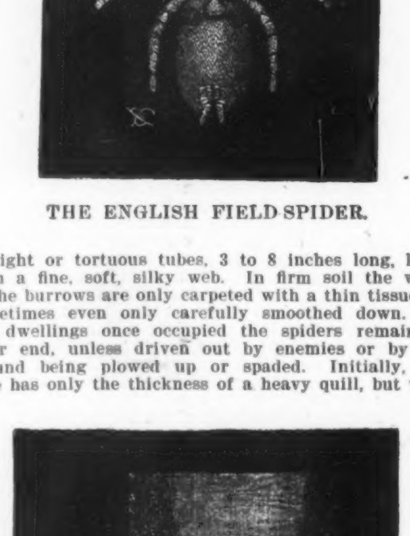


NEST OF THE MINING SPIDER WITH RAMIFICATION.

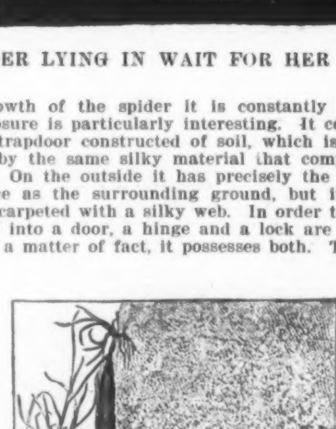
The spiders select for their nests damp, shady places in declivitous spots, and build them in such a manner that they are hidden by rubbish and bowlders or vegetation. They generally consist of single, straight or tortuous tubes, 3 to 8 inches long, lined with a fine, soft, silky web. In firm soil the walls of the burrows are only carpeted with a thin tissue, or sometimes even only carefully smoothed down. In the dwellings once occupied the spiders remain to their end, unless driven out by enemies or by the ground being plowed up or spaded. Initially, the tube has only the thickness of a heavy quill, but with the growth of the spider it is constantly enlarged. The closure is particularly interesting. It consists of a real trapdoor constructed of soil, which is securely bound by the same silky material that composes the lining. On the outside it has precisely the same appearance as the surrounding ground, but its underside is carpeted with a silky web. In order to convert this lid into a door, a hinge and a lock are required, and, as a matter of fact, it possesses both. The hinge consists of very close and firm silk, the lock of a number of small holes on the inner side opposite the hinge, into which the spider inserts her front legs and fangs, thus drawing the door firmly to, when danger threatens from the outside. When the spider sets out for prey she lifts up the door and lets it drop to after her; when she desires to enter again she raises it with the aid of her strong feet.



THE ENGLISH FIELD SPIDER.



SPIDER LYING IN WAIT FOR HER PREY.

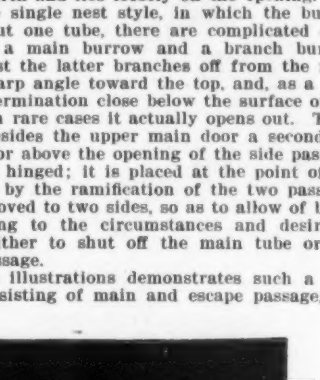


NEST OF THE ENGLISH FIELD-SPIDER.

One of our illustrations exhibits the spider in the act of blocking the door with all her might and endeavoring to resist an effort to open the door by means of a penknife. The door in this case is built in the shape of a cork stopper. It is rather thick, consisting of soil and web, is broader above than below, and closes the aperture as effectively as possible. The other style of door, which, however, scarcely occurs in Europe, is of the wafer shape, in which the door consists only of a silken web without admixture of earth and lies loosely on the opening.

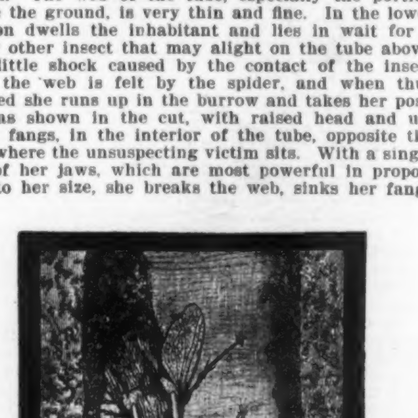
Besides the single nest style, in which the burrow consists of but one tube, there are complicated ones, composed of a main burrow and a branch burrow. In such a nest the latter branches off from the main shaft in a sharp angle toward the top, and, as a rule, has a blind termination close below the surface of the earth; only in rare cases it actually opens out. These nests have besides the upper main door a second underground door above the opening of the side passage, which is also hinged; it is placed at the point of the angle formed by the ramification of the two passages and can be moved to two sides, so as to allow of being used, according to the circumstances and desire of the spider, either to shut off the main tube or the secondary passage.

One of the illustrations demonstrates such a construction, consisting of main and escape passage, the latter being closed by the gate. We perceive that it is elliptic in form and has a lobulated appendage at the lower end, so that the diameter of the door exceeds that of the tube. In case of an attack, the spider will try to shut off the main passage; failing in this, and if the aggressor is stronger, she will flee into the side branch and draw the door to after her. Should the enemy pursue her even to here, it will be an easy matter for her to pierce the thin layer that separates her from the surface and make good her escape.



FEEDING APPARATUS OF THE ENGLISH FIELD-SPIDER—CROSS-SECTION.

The burrow of the aforementioned mining spider occurring in England has no trapdoor, but rises like a closed miniature chimney, made of the same material as that of the other burrowing spiders, a few inches above the ground. It generally leans against something with the upper portion—in our illustration an earth wall—or is fastened and supported by stones or plants. The web of the tube, especially the portion above the ground, is very thin and fine. In the lower portion dwells the inhabitant and lies in wait for a fly or other insect that may alight on the tube above. The little shock caused by the contact of the insect with the web is felt by the spider, and when thus notified she runs up in the burrow and takes her position as shown in the cut, with raised head and uplifted fangs, in the interior of the tube, opposite the spot where the unsuspecting victim sits. With a single bite of her jaws, which are most powerful in proportion to her size, she breaks the web, sinks her fangs deep into the body of the insect, drags it through the resulting opening, which is closed up again later on, into the tube and stores it safely away. The head of the mining spider and of the English variety is especially strongly developed. It virtually consists only of a very powerful claw-like pair of jaws, studded



SPIDER SECURING HER PREY IN HER NEST.

with strong teeth and bearing at each end a movable fang, which can be thrown out and withdrawn like the claws of a cat. Our engraving represents an enlarged cross-section through such a jaw. The fang at the end of the jaw is hollow, like the poison fang of a snake, and like the latter is connected with a bag which actually contains poison, even in the case of our spider. On sinking the fangs into the body of the victim, a portion of the venom from the bag is emptied through the fangs and the insect immediately becomes stupefied, so that sometimes our little cave-dweller can successfully attack even larger animals than itself. Its bloodthirstiness knows no limits, and every victim that carelessly settles down on its habitation finds it ready for a fresh attack, though its magazine may be filled to the brim.—For our engravings and accompanying description we are indebted to Fuer Alle Welt.

JAN SZCZEPANIK'S BULLET AND DAGGER-PROOF WAISTCOAT.

THE long series of attempts upon the lives of monarchs and presidents of republics constitutes one of the saddest and most touching chapters of the history of our era. There certainly is no dearth of safeguards for their frustration, but in the face of the sagacity and boldness of some fanatics, who are ready to sacrifice their lives, all precautionary measures have proved inadequate. The various attempts to protect the endangered persons, at least against attacks from close quarters, by bullet or dagger-proof coats of mail, have heretofore given only unsatisfactory results. The "Panzer" of the ingenious Polish inventor now solves the problem, at least inasmuch as it insures against bullet wounds and stabs the parts immediately covered by it. Strange to say, it is not made of metal, but of silk. As will be seen from the illustrations, it resembles a sleeveless *gilet*, closed in the front and

a. Shape of the projectile after firing at the vest with a hard foundation.
b. Shape of the projectile before and after firing at the body or soft foundation; distance, five paces.

reaching from the waist to the neck. The front is formed by a single layer of the protective fabric, which, by the way, has about the thickness of the material of a winter overcoat, while the back resembles exactly that of an ordinary waistcoat. The "garment" is closed at one side by means of hooks and eyes. Weighing hardly 1½ kilos, it is so thin and light that it can be worn unnoticeably and without inconvenience under the top clothes. The smooth, pale yellow fabric consists of undyed silk; its resistance to shots and stabs is owing to the elasticity and cohesion due to the peculiar connection of the threads.

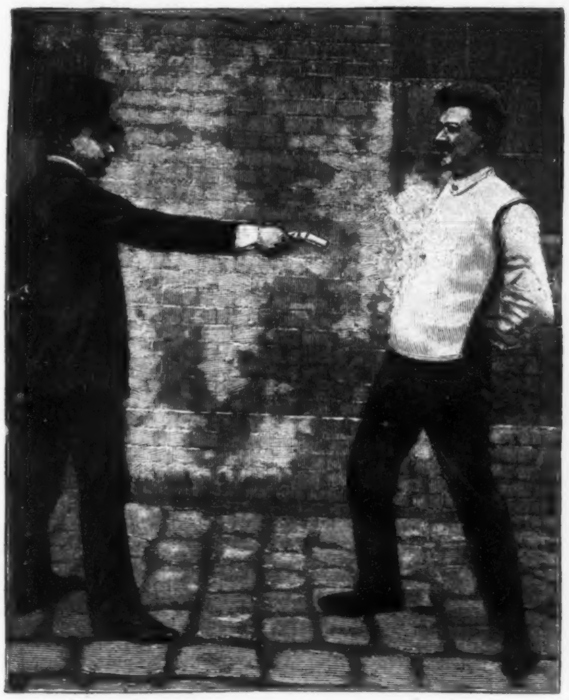
The most powerful lunges directed against the breast of a man wearing the waistcoat, with a sharp dagger or a pointed file, such as was used by Luccheni in attacking Empress Elizabeth, rebound powerlessly from the texture, without leaving a mark. The would-be assassin would certainly not have time to lift his arms for a second thrust after the first fruitless attempt.

Highly impressive and dramatic are the firing tests upon a live person, who, in the consciousness of his invulnerability, calmly and without moving a muscle exposes his breast, protected by the wonderful silk fabric, to the otherwise death-dealing bullets. Despite his faith in the impermeable vest, it is still a somewhat unpleasant undertaking to empty at arm's length a 7-millimeter revolver, whose projectile at the same

THE BULLET-PROOF VEST AS UNDER-GARMENT.

distance pierces a thick board, at a live person. The bullets rebound from the vest like hailstones from iron armor and drop to the ground with the point flattened. The places at which they struck are marked by small gray spots. Naturally, the Szczepanik protector, despite its high price, has immediately met with a brisk demand. A large number of persons of high rank are already using it. An especially careful gentleman is wearing two of them, one on the chest and one on the back. The news of the invention and application of an actually bullet and dagger-proof coat will, it is hoped, have the effect of deterring would-be assassins from direct attacks. Such an effect would indeed be most beneficial.

Jan Szczepanik, who is but twenty-seven years of age, has quickly risen from a Polish village schoolmaster to one of the most eminent inventors of the day, especially in the domain of the textile industry. The introduction and exploitation of his fifty-five patents has been taken up by the Société des Inventions Jan Szczepanik et Cie. His production of weaving cards by means of photography and electricity, which is causing a complete remodeling of the weaving industry, and his three-color loom, on which with only



FIRING A REVOLVER UPON THE VEST AT TWO PACES DISTANCE.

three colors textures of all the natural shades can be produced, have made him world-famous. His researches and experiments in weaving led him to the invention of a thread combination of extraordinary resistance and toughness. He succeeded, by the introduction of improvements, in augmenting these properties of the fabric, gradually to imperviousness to bullets. In this manner he finally arrived, without directly striving for it, at the invention of his "Panzer," for which the silkworm and not Vulcan furnishes the raw material.—For our engravings and the accompanying description we are indebted to the Illustrirte Zeitung.

CRUDE PETROLEUM AS FUEL.

By ROBERT P. SKINNER.

MUCH is being said these days about the use of crude petroleum as a fuel for steam navigation, and without in anywise desiring to discount the future of that important product, it remains a fact that to-day, with the exception of comparatively unimportant local steamers operating in the inclosed Caspian Sea, there is but one important company making use of this new fuel upon a serious scale. This corporation, the Shell Transport and Trading Company, of London, is principally owned by Sir Marcus Saul, who is also the

THE VEST WITH BULLET MARK.

possessor of valuable petroleum territory in Borneo, and who has become the pioneer in this proposed substitution of petroleum for coal, from motives of very direct self-interest. Two very great difficulties stand in the way at present of the rapid extension of the use of petroleum at sea, the first of these being the impossibility of finding the fuel practically available at ports of call generally, and the second the attitude assumed by various administrations.

It is easily understood that much time and capital must be forthcoming before storage tanks can be set up in seaport cities generally, and the opposition of public officers will yield to educational treatment. In the city of Marseilles the first steamer to arrive in port dependent upon oil for fuel was forbidden to enter the inner harbor until the connections between the boilers and the oil-bunkers had been detached, and the alleged menace to shipping thus removed. In another instance and in another city a petroleum-propelled steamer caused a considerable amount of damage, not through any defect in the method of handling the oil itself, but from the fact that the fuel escaped in some manner into the port, where it ignited, causing loss of property.

The steamers in the Caspian Sea burn a residue of Russian petroleum, called "astatki," of which Mr. R. Traill, of Armstrong, Whitworth & Co., has declared that the calorific power is 24,000 units, as against 15,000 units for the best Welsh coal. Mr. Traill has said that this fuel has an advantage of 30 per cent over coal, and that the combustion is so perfect as to evaporate twice the amount of water, instead of one-third more than that of the best Welsh coal.

"We find," he continues, "that we can evaporate under ordinary conditions in a marine boiler from 15 to 16 pounds of water per pound of liquid fuel. Now, with the best achievements of steamers using Welsh coal, 8 pounds is the utmost that can be obtained. The chief oil which is now adapted for liquid fuel is that which is obtained from Borneo, and which is used in its crude state as it comes from the wells. Any combustible liquid, however, is suitable, as, for example, shale oil, blast oil, creosote oil and other tar oils. The latter oils which I have mentioned are not so suitable, their calorific value not being so high. Shale oil, I may say, is found to evaporate a far less amount of water, as compared with Borneo oil or astatki. It can be adapted to any form of boiler, and requires very little attention, effecting a saving of labor, especially in large installations. This is especially the case in steamship fires, only one attendant being necessary in the stoke-hole to each watch, and in some steamers the engineer can do the necessary work.

"Less fuel and less space is required than for coal, and the carrying capacity of the vessel is thus increased. The wear and tear of boilers using liquid fuel is reduced to a minimum owing to the absolute uniformity of temperature in the furnace, there being no opening and shutting of doors, stoking, etc., which attends the use of coal. In the steamers passing through the Suez Canal, or steaming slowly through a fog and blowing off steam, the loss of fresh water is avoided by extinguishing one or more burners in each boiler. I may say that in the firm with which I am connected I have obtained the consent of Lloyd's Committee to carry fuel in all spaces in the ships, such as in water-ballast tanks, coffer-dams, etc., so that as far as steamship oil is concerned, all that remains to be done is to make the necessary alterations required for carrying the fuel. The expense is very small compared with the great advantages to be obtained from using the oil."

In the case of the steamer "Strombus," which was not permitted to enter the port of Marseilles with its petroleum connections, an interesting experiment was conducted, after local business had received attention, for the purpose of satisfying the authorities concerning the practicability of the new fuel and the minimum amount of insecurity involved. The prohibition has not yet been removed, however, and no petroleum steamers have since arrived. In consequence of this experiment M. Pasquier prepared a report, read before the "Société Scientifique et Industrielle," of this city, on October 25, 1900, in which he said:

"The ships of the Shell Transport and Trading Company, installed for the transportation of petroleum in tanks, consist of a series of independent cisterns, limited fore and aft by a coffer-dam. These ships carry ballast under the boilers and the cook-rooms. They are provided with a battery of pumps, arranged for the discharge of the petroleum. Ships are laden

with petroleum at Batoum and transported to the Extreme Orient. After the exploitation was commenced serious consideration was given to the matter of returning with a cargo shipped in the petroleum cisterns. To-day the problem has been solved, and now the cisterns, loaded with petroleum on the outward voyage, are charged with general cargo, notably rice and tea, on the return. The fleet consists of 24 petroleum steamers, the most recent of which have about 6,000 tons gross tonnage and 3,958 net. They are built of steel, and are quoted first in Lloyd's list. The combustible liquid used for heating the boilers of these steamers is a mineral oil coming from Borneo. Of the 24 steamers of the company 14 are equipped for the burning of oil, and can be arranged for the burning of coal. I have been able to see within recent months the manipulation of the boilers of the "Strombus" at Marseilles, one of the newest ships of the company. Upon this ship the oil is contained in sealed bunkers, which are easily transformable into ordinary coal bunkers. In the old ships of the line the oil is contained in the ballast under the boilers. The oil is sent by a pump into a superior reservoir, where it is distributed to the burners with which the fire-boxes are provided, and where it is pulverized by a jet of steam. With this mode of heating the boilers are guaranteed by a lining of refractory brick. Moreover, in the center fire-box there is a construction of masonry, against which the jet from the burners breaks itself. An arch also of refractory bricks occupies the middle of the length of the fire-box and extends to the top thereof, and there are interstices in the arch to allow the gas to be introduced for the purpose of combustion. To return to the use of coal all this masonry must be demolished, and the labor is considerable. On other steamers of the same line the oil is pulverized at the burners by a jet of steam, but it is sent to the burners by a pump, and is heated previously. The steam is also superheated, and warm air is sent to the burners at the same time as the oil and the steam. The important point established by the numerous experiments is that only 3 per cent of the steam produced is employed for the purpose of pulverizing the oil. The consumption of oil is about 500 grammes per hour, and per horse power developed. The use of oil for fuel reduces the labor account. Where 16 firemen are necessary for ordinary steamers 6 suffice where petroleum is used, and therefore labor is comparatively easy. A ton of Borneo oil is worth $9.73 at Bombay, Colombo and Yokohama; $7.29 at Penang and Hongkong; $8.51 at Shanghai and Kobé; $12.10 at Suez."

Certain other considerations on this subject are submitted in the June 27 issue of Fairplay, the British shipping journal, in which a correspondent says:

"At the annual meeting of the Shell Line in June last Sir Marcus Saul stated that it was possible to propel a vessel carrying 8,600 tons dead weight at 10 knots per hour on 22 tons of fuel per 24 hours, against a coal consumption of 45 tons, or, in other words that one ton of oil would go as far as two tons of coal. As it has hitherto been extremely difficult to obtain any reliable data regarding oil fuel the following particulars, gleaned from reliable sources, will be of interest as showing the results of actual working with oil and with coal. Very little seems to be known as to the cost of liquid fuel, but the last quotations I have heard of were 60 shillings ($14.58) a ton for Borneo oil delivered f. o. b. at Yokohama, and about 39 shillings ($9.49) a ton for Texas oil delivered f. o. b. at Seattle.

"At the latter end of last year two vessels of about 2,000 tons gross register were built at Belfast for the Norddeutscher Lloyd and fitted up for burning oil upon the Howden forced-draught system. The result of a three hours' full speed trial upon the first of these vessels in ballast trim was consumption equal to 13½ tons of Borneo oil per 24 hours, which worked out at 1.45 pounds per indicated horse power per hour, and which would probably increase to 1.61 pounds with the vessel loaded. I understand that sister vessels to that quoted have been running for years and giving excellent results upon a mean consumption of 19¾ tons of Japanese coal per 24 hours, some of very inferior quality. I think that I am quite within the bounds in saying that 16 tons of good Welsh coal would more than equal 19¾ tons of mixed Japanese coal. I should add that the cost of this oil delivered at Belfast was about $23.30 per ton.

"Sir Marcus Saul a year ago, in referring to the liquid fuel burning arrangements on his company's new steamship 'Strombus,' stated that 'the performance of this fine vessel is fully up to our expectations,' leading one to infer that the oil consumed showed, weight for weight, a saving of something approaching his statement (as reported in Fairplay of June 28, 1900), viz., 22 tons of fuel per 24 hours against 45 tons of coal. What are the facts?

"From what I have been able to glean the consumption of this vessel has been 30 tons of oil per 24 hours, against 40 tons of Newcastle coal.

"What has been the effect upon the boilers, furnaces, tubes, etc., of this vessel? She was ready for sea in January, 1900, and proceeded outward on coal fuel, so that she cannot have been using liquid fuel for more than sixteen months, and I understand that she needed extensive repairs to her tubes and furnaces when she arrived in the United Kingdom recently. Repairs to furnaces and tubes would not be expected, under ordinary working conditions, for the first six years, and what has happened to the 'Strombus' would happen under like conditions to any other first-class vessel. What then would be the probable outcome of converting a vessel with boilers of, say, four years old?

"It will therefore be seen that much has yet to be done before oil can successfully compete with coal. Reliable data will have to be obtained as to the life of furnaces and boilers under oil as compared with coal, the supply of oil will have to be guaranteed, as, should the supply give out, firemen could not be obtained at a foreign port at a minute's notice, and the price of fuel will have to be fixed (which at present it is not) and perhaps very materially reduced. The following is an instance of what the cost might work out to be: At Yokohama the 13½ tons of oil consumed per day by the Belfast vessel would, on the quotation referred to above, cost $197.09; the 20 tons of Japanese coal burnt by her sister vessels would cost $101.19, showing a saving of $95.99 a day in first cost in favor of coal. The case of the 'Strombus' appears to be rather the worse of the two."

In a discussion of the same subject by Mr. A. Morton Bell, of the Locomotive Department of the Great Eastern Railway of England, published in March, 1898, Mr. Bell said:

"The advantages of oil fuel on the locomotive are soon apparent to those accustomed to the footplate. Enough has been said to show that the employment of oil fuel is rapidly increasing. The writer would remark that in his opinion the introduction of the Holden system of burning has done more for this increase than any other, for it has removed the greatest objection that could be raised against liquid fuel, viz., the necessary alteration for the conversion of an ordinary coal-burning furnace to an oil-fired one."

Mr. Bell also said at that time: "There are 37 oil-burning engines now running on the Great Eastern Railway; 20 of these are passenger tank engines, and they are chiefly employed in the London suburban district; 15 are express engines; 1 is a six-coupled goods engine, and the last is a six-coupled shunting tank engine.

"The suburban engines are worked on combined fuels; that is, a coal fire is maintained in the grate and the oil fuel is injected and burned over it. This is found to be a convenient system of working for these engines on account of the constant stopping and starting. Their consumption in daily service is 17.8 pounds of coal and 10.7 pounds of oil per mile, against 40.4 pounds of coal when fired with this only."

Marseilles, U. S. Consular Office.

[Continued from Supplement No. 1362, page 21830.]

RECENT SCIENCE.*

II.

When a mathematician intends to analyze the effects of some cause over a wide series of phenomena, he willfully neglects in his calculations a number of secondary causes interfering with the same phenomena; he tries to ascertain the effects of the main cause in their simplest form. He calls then the result which he has obtained "a first approximation." Later on, after all the effects of the main cause have been studied in detail and verified upon thousands of applications, and when it appears that the main cause is not sufficient to explain all the phenomena, then a generation or two of explorers apply their energies toward disentangling the effects of all those causes which were neglected at the outset, but some of which may entirely alter the aspect of phenomena. They endeavor to find a new expression for the law enunciated in the first approximation, to discover some still broader generalization of which the first would appear as a consequence, or as a particular case only.

All sciences proceed in this way. All "natural laws" (as was admirably expressed once by Mendeleeff in the discussion of his own periodical law) have the same character of successive approximation—Kepler's laws of the movements of planets; the Boyle-Mariotte law of gases; nay, universal gravitation itself, whose cause and relations to attractions and repulsions at small distances have yet to be found. The more so is it true of the series of great discoveries which were made in 1858-1862: the kinetic theory of gases, the mechanical theory of heat, the periodic law of chemical elements, the physico-chemical basis of life, the cell theory, the origin of species. All these are now under revision, not because anyone doubts the mechanical origin of heat and electricity, or the physical basis of life, or the mutability of species, but because nearly all that could be done on the solid ground of the "first approximations" has been done, and new, still more generalized expressions of these natural laws are sought for. Of course, the "man in the street" and the semi-scientist who knows something of the results of science, but is not familiar with the methods of scientific discovery, never fail to raise at such times their voices and to proclaim "the failure of science." In reality, however, these are periods when the birth is prepared of still wider and still deeper generalizations.

This remark applies to the theory of evolution. The main points which Darwin and Wallace had so much difficulty to prove are now established truths. Nowadays there is almost no man of science who would not admit—even at the risk of being excommunicated by some church—that all the species of plants and animals have been slowly evolved in the course of ages out of a common stock of simplest organisms; that new species are evolved still; and that natural selection plays a very important part in fixing the variations which continually appear among both plants and animals. But the naturalist is no longer satisfied with these statements. He wants to know (as Darwin himself wanted) the cause of the variations which we call "accidental." Are they really "haphazard," or, maybe, do they take certain definite directions—partly under the influence of environment and partly under the guidance of previous evolution? And if it be so, what is the real part of natural selection in the evolution of new species? In other words, the naturalist is no longer satisfied with saying that—supposing there were no other causes at work but the accidental individual variations which appear in each species, the hereditary transmission of these variations, and natural selection in the struggle for life—these three causes alone would do to explain the origin of species and their marvelous adaptation to environment. He wants to know, not how species *may* have originated, but how they *do* originate in reality.[10]

It would be materially impossible to give even a faint idea of the immense, overpowering amount of work which is being done now in this direction, and still less of the numerous side-issues involved in this work. One group only of these researches will consequently be analyzed in the following pages: the work that is being done, experimentally, in order to see how the structure, the various organs, and the forms of plants and animals are modified by environment. "Experimental morphology" or "physiological morphology" is the name of this young branch of the science of evolution.

Variability is a law of Nature. Just as there are not two men exactly alike, so there are not two plants or two animals which would not differ from each other in many respects. It appears, however, that variability, even if it be quite accidental and "haphazard," has its laws. If we measure the length of the wings in a great number of birds, or the dimensions of many crabs, or the stature of many men, we find that the accidental differences below and above the average are submitted to the same laws as accidental errors in a physical or astronomical measurement. The number of small variations is very great, while the larger ones are relatively few—their number decreasing (roughly speaking) in proportion to the square of the size of the variation. This law, enunciated long ago by Quételet, has been proved by Wallace, Galton, K. Pearson, Weldon, Lloyd Morgan, De Vries, and many others to apply to most morphological and even to psychical phenomena. Moreover, it appears that although individual variations are greater, as a rule, than they were supposed to be, they soon reach a limit. Galton has proved, and biologists have confirmed it, that the more exceptionally some peculiarity is developed in a number of individuals, the more their descendants will have the tendency to revert to the average type; there will be "retrogression"—a "return to mediocrity"—unless some external or inner cause tends to accentuate variation in the same direction.

Altogether Quételet's law applies only to those cases in which variations are strictly accidental—that is, haphazard in the true sense of the word; in such cases the variations in one direction compensate those which occur in the opposite direction; and if we figure them by means of a curve, the curve is symmetrical. But in very many cases the curves are not symmetrical; the variations below the average are not equal in numbers to those above the average. We have then, as W. T. Thiselton-Dyer would say, "stimulated variation."[11] The curve may even indicate by its form the appearance of a new incipient species, modified in this or that of its features.[12] In such cases it is the duty of experimental morphology to step in and to find out which cause or group of causes may tend to modify the species.

An immense amount of work is being done now in this domain;[13] and it is a growing conviction among biologists that, at least as regards plants, there is not one single organ which could not be modified in a permanent way by merely altering the conditions of temperature, light, moisture, and especially nutrition, under which the plant is reared at certain early periods of its development. A few examples will better illustrate what has been achieved in this direction.

Beginning with the lower organisms, Chamberland and Roux proved in 1883 that the mere keeping of bacteria in an antiseptic substance will totally modify them. A new species will be created, which will differ both in form and physiological functions from its ancestor—a species which will propagate, retaining its new characteristics. L. Errera on the other side has proved, not only the powers of adaptation of certain fungi to new media, but the hereditary transmission of their adaptations as well—the new generation thriving much better in the new medium to which it has adapted itself than in the medium in which its ancestors formerly used to grow;[14] and the researches of Prof. Klebs, Ray, and Schostakowitch upon some other fungi further confirm and develop these views.[15] It may only be remarked that although these researches on lower organisms are considered by biologists as quite conclusive, and applicable to higher organisms as well, they do not very much appeal to those who are not specialists in these branches.

However, there is no lack of evidence taken from the higher plants. The experiments of Gaston Bonnier are especially striking. His earlier work was already mentioned in these pages,[16] and it was shown how, by transplanting several plants from a valley to an Alpine level in the Alps and the Pyrenees, or *vice versâ*, he entirely changed, in one single generation, both the general aspect of the plant and its inner structure. Both were rendered "Alpine" in a plant taken from the valley, and *vice versâ;* and new races or varieties adapted to their new surroundings—"incipient species," to use Darwin's words—were thus obtained under the direct influence of environment.

During the last few years Bonnier has made his experiments even more conclusive by submitting plants to artificial cold and excessive moisture—permanent in some experiments, and alternating with warmth and dryness in others. In this way he transformed valley plants into their Alpine varieties in the course of a couple of months. He took several annual and bi-annual plants—obtained from the same seeds or from a division of one individual—and divided them into four lots. Lot 1 was brought up in a box provided with a glass wall turned northward and kept by means of ice at a low temperature, which only varied between 38 deg. and 48 deg. Fahr., while moisture within the box was kept at from 80 to 96 per cent. Lot 2 was cultivated in the open air at Fontainebleau,

* P. Kropotkin, in the Nineteeth Century. Reprinted by permission of the Leonard Scott Publication Company, New York.

[10] Many works dealing with the present position of the theory of natural selection have been published lately. The following two may be recommended to the general reader: The Method of Evolution, by Prof. H. W. Conn, New York, 1900; and Ueber die Bedeutung und Tragweite des Darwin'schen Selectionsprincip, by L. Plate, Leipzig, 1900.

[11] See his most suggestive letter on "Variation and Specific Stability" in Nature, vol. li. 1895, p. 459.

[12] C. B. Davenport, "A Precise Criterion of Species," and J. W. Blankinship, "The Chief Differential and Specific versus Individual Characters," in Science, May 20 and June 3, 1898; fully analyzed by Varigny in Année Biologique, iv. 470 seq. The mathematical treatment of the variation curves is, as is known, busily carried on by K. Pearson. A comprehensible analysis of the methods used in these researches will be found in Geo. Duncker's Die Methoden der Variations-Statistik, Leipzig, 1899; and in C. B. Davenport's Statistical Methods, with Special Reference to Biological Variation, New York, 1899.

[13] Part of it has been already mentioned in these pages, Nineteenth Century, April, 1894.

[14] Bulletins de l'Académie de Belgique, 1899, p. 81.

[15] J. Ray, in Revue Générale de Botanique, 1897, vol. ix.; analyzed in full, with valuable remarks, by M. Radais in Année Biologique, iii. 501; Schostakowitch, in Flora, vol. lxxxiv. p. 88.

[16] Nineteenth Century, April, 1894.

and was thus submitted to the usual summer variations of temperature (59 deg. to 86 deg. Fahr.) and moisture (from 64 to 91 per cent). Lot 3 was submitted, like Alpine plants, to the extremes of temperature and moisture: it was brought up at daytime in the open air, and at night in the iced box. Finally, there was a fourth lot, submitted to the same conditions as 1 and 3, but less severe, in a warmer box. In two months the plants of the first lot, and especially those of the third lot (submitted to sudden changes), had already taken the general and the special characters of Alpine plants—smaller size; stronger stems with short internodes; smaller, thicker, and stronger leaves; and, with those of them which bloomed, a more rapid blooming. The plants of the third lot had even taken the reddish color of the leaves characteristic of Alpine plants (due in both cases to the presence of anthocyan), while those of Lot 1 remained quite green. Lot 2 remained, of course, unchanged; and the plants of Lot 4 were more similar to those which had grown in the open air than to those of the two other lots.[17] No better proof of adaptive forms created directly by environment (Buffon's and Lamarck's view) could be given.

Another series of equally successful experiments was made by Bonnier, in order to see whether Fontainebleau plants cultivated on the shores of the Mediterranean would not take the well-known characters of circum-Mediterranean vegetation, due to the special climate-conditions of the region (woody stems; broader, thicker, leather-like leaves with strong nerves; and so on). Two lots of plants, belonging to forty-three different species, some of them bi-annuals, but originated in each case from the same individual, were grown—one lot at La Garde near Toulon, and the other at Fontainebleau in soil brought from La Garde. Nearly all species of the first lot took, in the very first generation, more or less the Mediterranean aspect, but none of them showed variation in the opposite direction. During the second summer the changes were even more marked. The Fontainebleau species, *Senecio Jacobæa* (Ragwort Senecio), became similar in several of its characters to the Mediterranean species, *Senecio nemorosus*; our common ash, *Fraxinus excelsior*, became like the *F. parvifolia*, G. G., of the Mediterranean coasts; and so on.[18] The importance of these experiments need not be emphasized. When we see that environment so rapidly creates itself the adaptation, we shall necessarily be more cautious in speaking of the natural selection of quite accidental individual variations.

If Bonnier's experiments stood quite alone, they would already carry a considerable weight; but at the present time any number of similar researches and experiments could be mentioned—all telling the same tale of a *direct* action of the conditions of growth for producing considerable and rapid adaptive changes in plants. Joh. Schmidt, for instance, obtains at will the anatomical structure of the leaves in the sea-pea (*Lathyrus maritimus*) which characterizes the East Danish or the West Danish specimens of this species by simply adding more or less salt to the water with which he waters his cultures, or by altering the amount of exposure to sunlight during germination.[19] K. Goebel shows the alterations which strong light produces in leaves, and the potency of the habitual inherited forms.[20] G. Haberlandt, not satisfied with merely altering the color or the shape or the number of existing organs, creates a new organ for the secretion of water from the leaves of a tropical liana.[21] Hermann Vöchting, continuing his extremely interesting, previously mentioned researches into the effects of low temperature and considerable light-intensity, obtains in this way rampant varieties of plants, and maintains in them a sexual reproduction.[22] De Vries, by cultivating a South African composite plant, *Othonna crassifolia*, and its near congener, *Othonna carnosa*, in both moist and dry soil and atmosphere, obtains two quite different plants.[23] W. Wollny, taking up the whole question of the influence of moisture upon the forms and the structure of plants, proves by experiments conducted in three separate conservatories—one very dry, the other very damp, and the third of an average dampness—that this factor alone is capable of producing the most important modifications in plants, both in their forms and their structure. A great dampness increases, of course, the growth of the stems and leaves, but hinders the development of chlorophyl; the stomates appear on both sides of the leaves and increase in numbers and size; while the thorns of our common furze (*Ulex europæus*) are completely transformed into leaves—that is, he obtains by surplus moisture the opposite of what Lhôtelier obtained in a very dry atmosphere.[24] And so on.

In short, we have by this time a quite solid body of evidence to prove that in plants adaptive forms *are* created by the direct physical action of environment.

Let us next consider, then, two other series of researches which have a bearing upon two other important points of the theory of evolution. Both were made by the Dutch botanist De Vries, one of the greatest botanists living. For the last fifteen years De Vries has cultivated a great number of so-called monstrosities, or rather aberrant types, such as the five leaved clover or the many-headed poppy (*Papaver somniferum polycephalum*), of which the stamens have been transformed into a great number of carpels, so that the poppy-head is surrounded by a crown of secondary heads. It is now a favorite with some gardeners. The conditions under which these new varieties have been obtained were carefully studied by De Vries, and his conclusion is that—taking the poppy as an instance—it entirely depends upon heavy manuring or not, upon the keeping of seedlings wide apart or crowded, and upon the supply of temperature and light—upon *nutrition*, in a word (taking nutrition in its old, wide sense)—whether we obtain from the seeds of the many-headed variety of poppy a similarly many-headed progeny or individuals which will only have the rudiments of the additional heads. But these influences, to be effective, must bear on the plant in its early youth, during the first six or seven weeks after germination. The maintenance of a new variety is a mere matter of nutrition, De Vries says, and "selection is simply the picking-out of the best-fed individuals." "The acquired characters, as the name goes in zoology and anthropology, have their parallel in botany in the *nutrition-modifications*."[25]

Now—and this is the main point—De Vries, like most botanists, does not doubt a moment that these "acquired characters" are transmitted by inheritance from the mother plant to its progeny. Without such a transmission, of which the botanist sees such an abundance of illustrations, no cumulative selection would even be possible.[26] In fact, if a certain deviation from the normal type—say, a five-leaved clover—has been obtained by plenty of nutrition, the progeny of this plant will give as much as 50, 80, or even 97 per cent of plants showing the same variation—provided high nutrition were maintained. Even in bad conditions, with poor nutrition, the many-headed poppy shows a tendency to reproduce in a succession of generations the additional carpels. Of course, in order to fix the variation, a selection of two or three generations of best-fed individuals will be required.[27] But the accumulation of a newly acquired variation is so rapid that De Vries considers two or three—*maximum* five or six—generations as quite sufficient for obtaining the maximum of possible variation of a given character. Vilmorin, as is known, obtained the cultivated carrot out of the wild one in five generations; Carriere did the same with the radish, Buckmann with parsley, and so on.

The other group of researches by De Vries has perhaps a still deeper bearing upon the theory of evolution—I mean, his work upon the sudden appearance of what Darwin called "single variations." They are not submitted to Quételet's law, which applies only to the individual "continuous" variations, but they appear occasionally with certain plants, under certain conditions, and at certain periods with a striking force. In such cases a new species—quite well determined and fully maintained in its progeny, if precautions be taken to prevent cross-breeding—appears all of a sudden, with all its fixed specific characters. Not all plants show this capacity, the great number of them showing a remarkable fixity of characters[28] (Thiselton Dyer made some time ago some excellent remarks upon this subject in Nature, vol. li.), and out of a great number of species tested by De Vries only one, the *Œnothera Lamarckiana*, displayed the capacity of giving origin all of a sudden to several new species; but it possessed it to a wonderful extent, no fewer than seven new species having been obtained in the course of a few years—not by means of selection, but in consequence of spontaneous variation. Each of the new species appeared quite fixed in the cultures, the individuals of the fifth or sixth generation of the new species being exactly alike to those of the first generation. However, these facts are so significant, and yet so new, that their bearing upon the theory of evolution cannot yet be appreciated in full.[29]

It may be said, of course, and it has been said, that new races of domesticated plants and new varieties obtained by botanists in special conditions are not lasting; that they retain their new characters only so long as the conditions under which they have been bred continue to exist, but they return to their primitive form if they are let grow wild. But the same—we now learn—is true of wild species as well. The wild carrot and the wild radish also cease in a few years to be what they have been for hundreds of generations as soon as they are placed in conditions of an especially favorable nutrition. The Alpine plant surely is a very stable species or sub-species, but it becomes quite a new plant when it is grown in the lowlands. It seems therefore that we must accustom ourselves to consider the species as nothing else but a temporary equilibrium established, under given conditions of environment, between hereditarily transmitted dispositions (the accumulated result of previous evolution) and the given conditions of climate, living surroundings, and nutrition—a variable function, the mathematician would say, of these four variables. This is, at least, the conclusion one is forcibly brought to by the study of the researches faintly sketched in the preceding pages.

But what else are all other phenomena of Nature? Are they not, too, manifestations of a temporarily, more or less stable equilibrium between the various forces—an equilibrium which sometimes is destroyed in a few seconds or in a few hours, and sometimes, being itself a product of ages, requires ages for being altered?

(To be continued.)

[17] Comptes Rendus, 1898, vol. cxxvii. p. 307; and 1899, vol. cxxviii. p. 1,143.

[18] Comptes Rendus, 1899, vol. cxxix. p. 1,207.

[19] Botanisk Tidskrift, 1899, xxii. 166; analyzed in Naturwissenschaftliche Rundschau, xiv. 562.

[20] Flora, vol. lxxxii. 1.

[21] Festschrift für schwendener; analyzed in several reviews.

[22] Jahrbücher für wissenschaftlich Botanik, vol. xxv. 1893, p. 149; Berichte der deutschen Botanischen Gesellschaft, vol. xvi. 1898, p. 37.

[23] In Mutationstheorie, p. 103, he reproduces his photographs of the two plants. He gives also a photograph of Bonnier's Alpine and valley plants.

[24] Forschungen aus dem Gebiete der Agrikulturphysik, vol. xx., 1898, p. 397; Naturwissenschaftliche Rundschau, xiii. 617. A very suggestive work by Julius Sachs, "Mechanomorphosis and Phylogeny: a Contribution to Physiological Morphology" (Flora, 1894, p. 215), must be indicated in this place. He deals in it with a group of physiological causes, common to most plants, which necessarily must act in producing this or that form, and thus produce parallel forms in the different large divisions of the vegetable kingdom. Stahl's classical work on the influence of lighted and shaded position upon the leaves (Jenner Zeitschrift, xvi. 1883) may also be mentioned in this place, as also O. Hertwig's Mechanomorphosis, the work of Prof. Kny, and so on.

[25] Die Mutationstheorie, vol. i. p. 93, Leipzig, 1901, and in fact all the fourth chapter. The latest researches of J. MacLeod further confirm this idea. See also the previous important work of MacLeod Over de Bevruchting der Bloemen, Ghent, 1894 (summary in French at the end of the volume).

[26] See Comptes Rendus, vol. cxxviii., 1899, p. 125; also pp. 97-100 of Die Mutationstheorie, vol. i. It must also be remarked that De Vries has a voice in these matters. He is one of the pleiade of anatomists represented by Van Beneden, Boveri, Strasburger, Guignard, Fol, the brothers Hertwig, Maupas, Blütschli, Verworn, and many others, upon whose work Weismann's theory—or, rather, rapidly altered theories—was based, and he is the author of Intracellulare Pangenesis. The substance of this work was mentioned in previous review; Nineteenth Century, December, 1892.

[27] Hugo de Vries, "L'Unité dans la Variation" (Revue de l'Université de Bruxelles, iii. April, 1895); "Alimentation et Sélection" (Volume jubilaire de la Societe de Biologie, Paris, 1899). Both summed up in Mutationstheorie, first fascicule, ch. iv.

[28] Judging from a footnote in Mutationstheorie, the plants capable of such variations may be more numerous than may be thought.

[29] In Mutationstheorie, of which the second fascicule is just out, the new species are fully described, with colored plates and photographs of seedlings.

BLINDNESS FROM WOOD ALCOHOL.

RECENT publication of a paper read at the last meeting of the American Medical Association brings once more to notice the poisonous character of wood alcohol and more especially its peculiar power of destroying the sight, says The Druggists' Circular. In this paper is reported by Dr. H. Moulton a case of blindness occurring in his practice from drinking bay rum which he compares with reported cases due to methyl alcohol and preparations containing it. The symptoms indicate that the bay rum, like certain essences of ginger, etc., was made from methyl alcohol.

Of unusual interest is Dr. Moulton's summary of like occurrences. "It is worthy of note," he says, "that we know of no other substance which when swallowed selects for attack with such uniformity the optic nerve and retina. Those who record cases of blindness due to this cause mention in all thirty persons who drank from one to two drachms to an ounce or more of the substance, and were made sick by it. Fifteen, or 50 per cent, lost their sight. One of the first cases on record was published by the present writer in 1899. Four preceded and others have followed, till now fifteen or more are described in literature. A dozen or more cases from essences also are reported, a sufficient number to afford reliable data for comparison. An analysis of fifteen cases of wood alcohol blindness, and of twelve cases of blindness due to the essence of Jamaica ginger, etc., shows the striking identity of important symptoms."

These symptoms, unless the dose is large enough to produce coma, do not appear until the second or third day, sometimes later, and then nausea, vomiting and headaches supervene. Visual disturbances are delayed for a day or two longer. In about twelve to forty-eight hours blindness becomes total. In a few days some useful vision is restored, only to be lost again in a short time. In every case where the field of vision was studied, a central scotoma was demonstrated, except once, namely, in a case of so-called ginger poisoning. Narrowing of the field was equally characteristic. Atrophy of the papilla was universal, most pronounced in the temporal half and preceded in a few cases by a low grade of visible neuritis. In about half of each group the retinal vessels were narrowed, in the other half normal. Other symptoms are "excitement," "coma," "semi-coma," "depression," "coming and going of sight," "sensitiveness to pressure and to movement of eyeballs," etc. Only two cases recovered normal vision, one in each group.

In a synopsis of cases appended to the paper we are reminded that exposure to the fumes of wood alcohol has resulted in the same manner as ingestion. In a discussion which followed, mention was made of a case in which an accidental substitution of wood alcohol was made for grain alcohol in bathing, during three or four days. Intense dermatitis followed, and ten days later slight impairment of vision was noted; the patient happily escaping pronounced attack, the liquid not having been freely absorbable by the skin.

In a few of the cases the effect of the drug on the optic nerve was counteracted more or less by treatment in which pilocarpine was the leading agent. It is to be especially noted that in these cases the treatment was begun within a few hours of the onset of blindness, and this points out the importance of being able to promptly recognize the nature of the attack.

It is manifest from what has been learned regarding wood alcohol, including the purified article, that it is capable of producing most disastrous results.

INJURIES TO THE EYE CAUSED BY INTENSE LIGHT.

THERE may be some general interest in the following cases of optical phenomena brought about by exposure of the eye to intense light.

Prof. M., while working in a rather dark corner of his laboratory, accidentally broke a low-resistance circuit in which an electric current at a pressure of 500 volts was flowing. The arc formed was about a foot from his eyes and appeared like a ball of fire rather more than 6 inches in diameter. Immediately there was a feeling that something had "given way" in his right eye, though no pain was experienced. Shortly afterward he noticed that a part of the retina was permanently affected, the injured portion being in the form of a square, with the center of vision in one corner. The sharp outlines of this field could be easily distinguished, and upon closing the eye, fan-shaped flashes of a violet color spread out from one corner over the injured area at equal intervals of several seconds, their recurrence being entirely involuntary. After being some time in the dark the flashes of color ceased.

There was in general an apparent lack of illumination over this part of the retina, accompanied by a loss of power to properly distinguish colors, more especially green. The outlines of objects were blurred, their dimensions also appearing to be reduced by about one-quarter. Printed letters could not be recognized at more than half the distance at which they were easily read by the uninjured eye. Parallel lines seemed to converge over the injured portion. In walking and riding he noticed at a short distance ahead what seemed to be a spot a few inches in diameter and about two inches high, which he often turned his wheel aside to avoid. The injured eye was also very defective in estimating distances. The effect lasted several weeks with almost undiminished intensity, but has since been gradually disappearing.

The second case is that of Mr. R., who in May, 1900, imprudently observed for some time the partial eclipse of the sun with his eyes unprotected in any way. No effect was noticed until late in the day, when in looking over the hillside he saw apparently a flock of eight of ten red birds whose movements were very erratic. Since the birds appeared wherever he looked, he carefully examined the field of vision, and discovered that the sun had formed a crescent image on the center of the retina of the left eye.

The color of the image was green wtih a narrow red border. The injured area seemed to be quite blind, and parallel lines diverged around it, this effect being just the opposite of the previous case. The injury is always noticeable and very annoying, especially in reading. In making observations in the physical laboratory he had to discontinue the use of his left eye, which he had been accustomed to use constantly. The effect is still noticeable after a year, though it causes much less annoyance.

A case exactly similar to this has been described, in which the injury had lasted ten years.—Frank Allen, in Science.

SCENES FROM THE KILIMA NJARO.

In recent years this gigantic mountain, situated in the northern part of our East African Colony, has not been the scene of such massacres as formerly appalled the friends of colonization. It has not become an Eden of existence, for the daring natives sometimes object strenuously to comply with the wishes of the imperial authorities; but gradual progress is apparent in the development of those friendly relations which are the desideratum of colonial policy. The government is somewhat facilitated by the mutual enmity of the different tribes, though expeditions to purloin their neighbors' cattle have passed into history.

We present our readers with several illustrations, including a tribal assembly. A man like Mareale, the Dschagga chieftain, a well-known friend of the Germans, is to a certain extent an ideal character. Others are less reliable; for instance, Schangali, whose peaceable disposition would have been vouched for by the missionaries, though the officers of the station did not share their optimistic views. We ourselves have come to a different conclusion from that of the sentimental friends of colonization, and believe that negroes, even when professing conversion to Christianity, are not to be trusted. Strict discipline alone awes them into submission. Capt. Johannes, now employed in Darres-Salaam, was for many years monarch of Kilima Njaro and knew well how to enforce obedience to his orders in a territory frequently difficult to manage.

The natives are divided into two general groups, the Wadschagga and the affiliated Massaï and Wandorobbo. Our acquaintance with the former was earlier and more intimate on account of their comparatively pliable temperament. The Massaï and Wandorobbo are a peculiar people, and their character is not yet fully comprehended. The Wadschagga live in round or square huts after the fashion of the Suaheli and till the ground; while the Wandorobbo have been known as a people devoted to hunting, feeding on the flesh of the animals they killed, fashioning implements, chiefly for use in hunting, out of skins, horns and claws, and bartering skins for products of the agricultural tribes on the Kilima Njaro, in Meru, in the Umbugwe district, in the Pare and Ngueno Mountains, and in the districts of Kahe and Aruscha.

The Massaï tribes have been generally nomadic, raising here and there large herds of cattle, fighting their way and taking tribute of their relatives, the Ndorobbo or Wandorobbo. Hunting animals was too low an occupation for the Massaï warrior. Men were his game, and he considered it as especially his prerogative to take as tribute from the "poor devils," as the word Wandorobbo signifies, whatever he needed of the products of their chase.

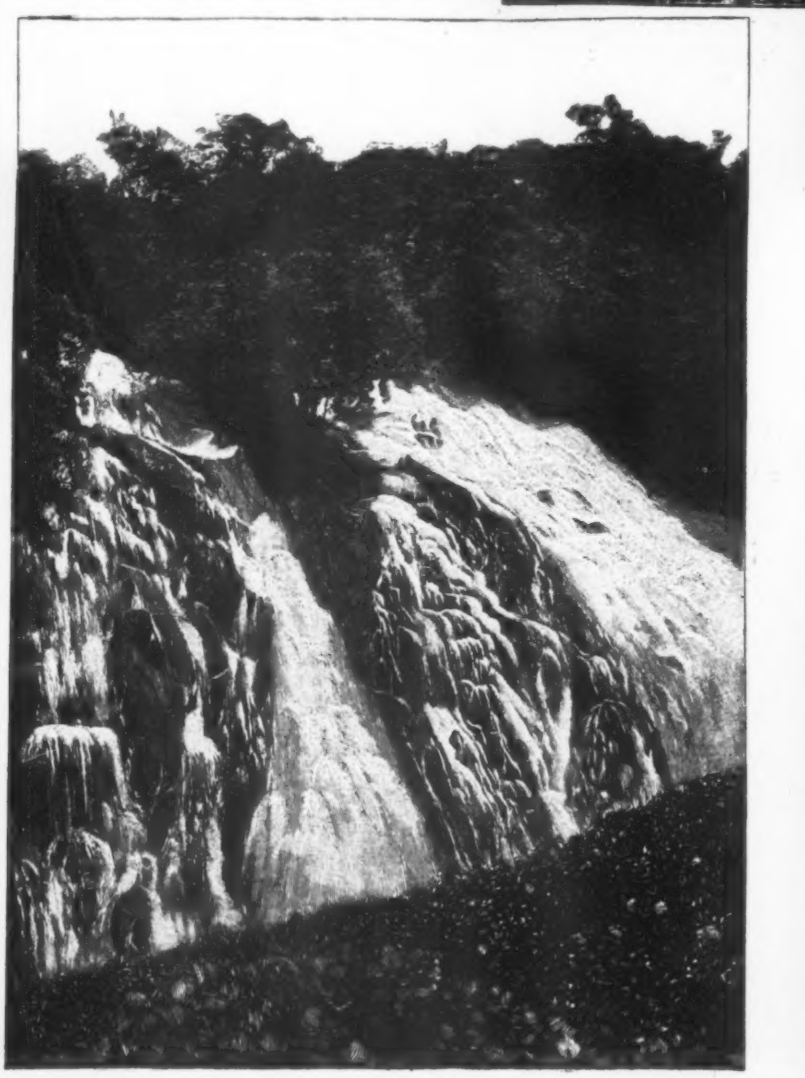
Some nine years ago East Africa was visited by the great cattle and game plague. The agricultural tribes, though incurring heavy losses, managed to survive the hard times, until the small residue of their possessions had increased again. But the proud Massaï perished miserably in great numbers. I shall never forget meeting in Tanga a Massaï warrior begging. He was a giant, but shrunken and dried up like a mummy, while the lines of his huge, bony structure were quite visible. He stared at me with an expression denoting the semi-insanity of starvation. Many of these warriors submitted to a kind of voluntary servitude; others condescended to lead lives like the Ndorobbo or Wandorobbo. Bronsart von Schellendorf relates such facts in his recent interesting work, "Tales of Animals and Hunting in East Africa."

They have gradually come to resemble the Wandorobbo and have assumed their name. Although they were averse to hunting, they have become as expert hunters as the Wandorobbo themselves. In many districts they can hardly be distinguished; their manner of living and the clothing of the men being identical. The women dress in the fashion of the Massaï, wreathing conspicuously coils of brass and iron wire in a peculiar manner about neck and arms.

With regard to the future of these races, it may be assumed that the natives of Hamitic extraction (descendants of Ham) are capable of a higher civilization than the Bantu people and their branches, notwithstanding that the latter take readily to agricultural pursuits. The former are more sedate in character, while the Wadschagga exhibit a good deal of the usual frivolity of negroes. This characteristic, coupled with a great liking for ceremony, is very prevalent among savage tribes.

The "Schauri" is one of their solemn assemblies for consultation and is very popular in East Africa. It is an interesting sight—these many savage figures earnestly debating, squat on the ground, while the tall, broad spearheads, splendid specimens of aboriginal art, glisten in the sun. The schauris frequently aim at serious results, and the elder chieftains of Great Aruscha never attend them with a clear con-

IVORY CARAVAN IN MOSCHI.



PANGANI FALLS IN USEGUHA.

WANDOROBBO WOMEN.

PICTURES FROM THE KILIMA NJARO. AFTER PHOTOGRAPHS BY A. KERIM IN TANGA.

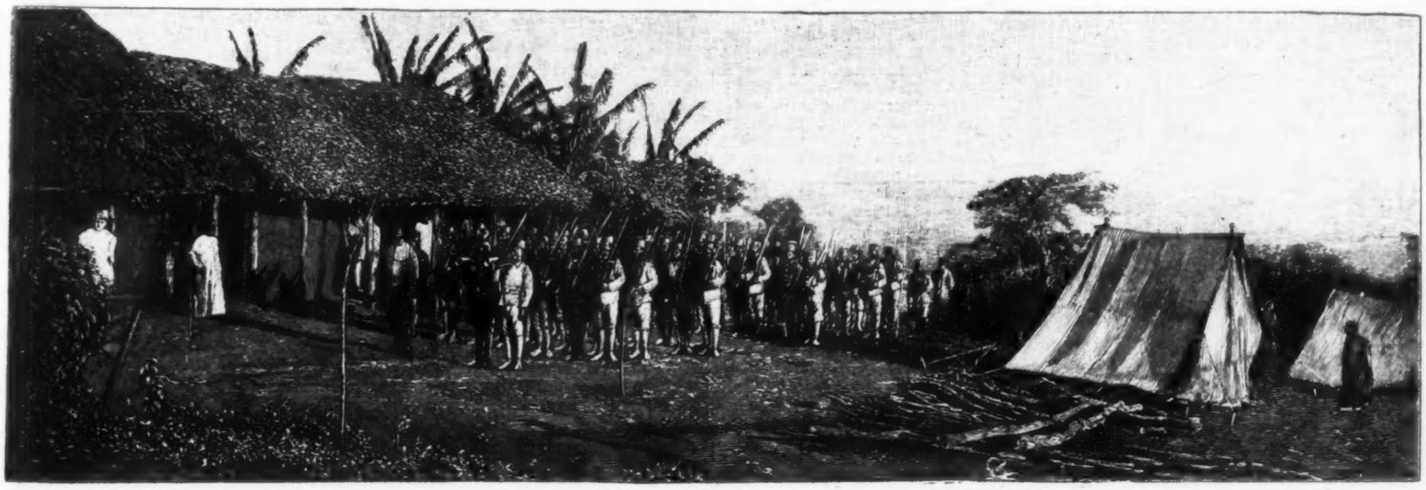
science. These are the bold and sullen inhabitants of the mountain regions and much more independent than the Wadschagga. It will require a prodigious effort to bring them to an unconditional recognition of German supremacy. This is absolutely essential. In this way alone can the beautiful mountain become productive and lucrative, and at the same time confer lasting benefits on the natives.

Among some of the tribes, which are but slightly touched by the Arabic civilization of the coast, the missionary societies find a fertile field for their activity. All the reports of visitors concerning the progress of the missions are satisfactory and encouraging, though some danger may possibly lurk in the proximity of the Catholic and Evangelical missions. Prof. Dr. Hans Meyer is perhaps the most experienced explorer of the Kilima Njaro. This is evident from his last work: "Travels and Studies in the Kilima Njaro." He considers it doubtful which of the two missions will be most successful in the end. The Catholic mission is perhaps most promising, on account of the practice of keeping the negroes as far as possible in the neighborhood and setting them to work. It is too early to form a conclusive opinion.

The Kilima Njaro, covered with tropical vegetation, rises abruptly from the arid plain. The contrast is exceedingly striking. From the top of the ice giant rush continually the clear mountain streams, which the Wadschagga attempt to turn into their fields. Half-way up the slopes is a circuit of splendid banana plantations. Here flourish, too, the coffee plant and various other productions of the tropics. On account of the heavy mists plants requiring much light cannot always be cultivated. In general European vegetables can be produced. The potato has become acclimated; indeed, this "ground apple" appears to be destined to crowd out some other bulbous vegetables, which originally were imported from South America and spread over the country.

The swift and splendid mountain waters unite in the Pangani, the most important river in the northern part of our territories. The point where the Pangani enters the sea was taken as the site of the town of the same name. After receiving several tributaries the river takes its course through a plateau, not presenting noticeable features, to the southern extremity of the massive mountains of Pare and Usambara, until on approaching the border, it rushes down in the great cataracts, which in the blaze of the tropical sun flash like brilliants of indescribable beauty. These will be visited by multitudes of tourists as soon as traveling facilities have been sufficiently improved. The railway from Tanga to Korogwe will no doubt be extended before long.

After railroad communication is once fully established the traveler, while his steamer is discharging merchandise and taking on a new cargo, if he does not care to venture a trip to the coffee plantations of Usambara, will secure a charming excursion by the simple words: "A ticket for Pangani Falls, please."—For our engravings and the accompanying description we are indebted to the Illustrirte Zeitung.



DRILL OF THE FIRST COMPANY OF THE MOSCHI STATION.

CHIEF SCHANGALI OF MADSCHAME, WITH HIS PEOPLE, IN A SCHAURI.

PICTURES FROM THE KILIMA NJARO. AFTER PHOTOGRAPHS BY A. KERIM IN TANGA.

AMERICAN INFLUENCE ON BRITISH INDUSTRY.

At the recent annual dinner of the Lancashire members of the Iron and Steel Institute (who formed what is known as the "Car A" party during the visit of the Institute to the United States some years ago), Mr. F. Monks, of Warrington, read a paper dealing with the probable influence of American enterprise upon British industry, says The Practical Engineer. The speaker urged that, as contrasted with the British plan of slow and often painful growth, with very high on-cost charges on a small production, the American methods meant a minimum of on-cost charges, efficient oversight, with labor-saving appliances and abundance of capital to carry stock, and waiting for remunerative prices under more favorable conditions. He thought that the English trade unions would not be strong enough to resist the introduction of American methods and the practice of driving at high pressure. Whether the struggle would end in a gigantic strike or a compromise it was impossible to say, but American capital was undoubtedly fighting the British employers' battle for a better control over the works and freer labor. He thought that the depreciation in the press of our British methods of conducting business, the constant wail of the lack of enterprise in adapting ourselves to the requirements of customers, and the oft-repeated assertion that we were losing our hold upon the markets of the world was rather overdone. True, our relative position in the manufacture of iron and steel had changed from the first to the third place, and we now followed rather than led the trade; but how could it possibly be otherwise with a constantly increasing demand and a diminished supply of raw material, and with a system of royalties that gave to the mine owner a handsome revenue for which he did nothing but allow others to toil and spin for his benefit? Our industries had grown up on cheap raw material, and on this they still depended. This was a condition not confined to Britain alone, and cheap and dear were only relative terms, as measured by the standard of value, which was the purchasing power of gold. As to the main question—whether we were declining as a manufacturing nation?—he said, decidedly not. The mere fact that we could not keep pace with the demands of the world was no sign of decline, but it might be a sign that the limit of production was very near. Cheap labor was essential to cheap production, and the limitation of production was dependent upon the supply of labor. Hitherto we had not been driven, like the Americans, to use our brains to make up for high wages and the scarcity of efficient workmen. We had enjoyed the advantages of an ample supply of labor at moderate wages, and the system of small works run by inadequate capital had forced employers to yield bit by bit to the demands of labor, not only for increased remuneration, but for the right to restrict the output, and practically for the control of the workshops by union officials. This conservatism of labor we would have to fight sooner or later; American capital would force us to fight sooner than we expected. He believed that we should see a new birth of industrial prosperity where the capacity of the laborer would be vastly increased, and his remuneration also, by his intelligent appreciation of the advantages of larger capital, higher organization, and more efficient control.

BOOTWORKERS' OPPOSITION TO MACHINERY.

Riotous scenes have occurred at one of the centers of the army boot industry in Northamptonshire, by the operatives demonstrating against the use of shoe-lasting machines. Some 200 riveters and finishers went out on strike at one of the principal factories, and persuaded the machinists not to go to work, paying their return fares home. Crowds of shoe hands subsequently paraded the streets with a band and flags, and made noisy demonstrations outside the factories. Stones and mud were thrown at one of the leading manufacturers as he left his workshops, and a commercial traveler attempting to drive through the crowd had a narrow escape of being overthrown on reproving the mob. The operatives held a mass meeting and decided to go out on strike if the manufacturers persist in using machinery. Since the great boot war in this country American footwear has been gaining in favor. The secret of this success is that the maker in the States never does by hand what can be accomplished quicker and cheaper by machinery. In the making of a single boot it is estimated that an American firm will employ a hundred machines, and among them is the one which is the cause of the present strike at Northampton—an ever-recurring, short-sighted protest against the march of invention, and as useless as trying to sweep back the tide.

At the recent exhibition of bootmaking machinery at the Royal Agricultural Hall many ingenious mechanical contrivances were exhibited, all tending to take the place of the human laborer. One substitutes wire for tacks at the toes; another cuts and works 5,000 button-holes a day at the rate of 16 a minute; and yet a third cuts the pegs and drives them into the soles up to the head, and by an ingenious arrangement the pegs are cut off inside the shoes, level with the inner sole, so that everything is perfectly

smooth inside; 600 pegs per minute is the speed attained. English inventors have not been quite asleep. One English duplex eyeletter punches two holes and eyelets them in pairs at one time. Another, to sew on buttons at the rate of 260 in five minutes, is also English. Although all fresh inventions are not necessarily American, yet few machines seem to have been suggested by English operatives in the boot factories, and the reason assigned is that they have no inducement to use their brains in this direction, with the English patent laws always acting as a discouragement. Not only have the Americans a larger number of machines, but it is generally agreed that they get more work out of them. In their country there is no restriction of output, and, consequently, employers get the maximum advantage from their expenditure in mechanical inventions.—The Mechanical Engineer.

THE DIGNITY OF CHEMISTRY.*

By H. W. WILEY, U. S. Department of Agriculture.

CHEMISTRY as a profession may be said to have completed its hundredth year, and we have met to-night to celebrate the quarto-centennial of chemical organization in America.

In our democratic country all attempts to create a class or caste should be discouraged, especially if the attempt be made to endow the class with unusual or special privileges. We have no place for an hereditary or purchasable aristocracy, but in the function of the civic body there must be specialization, and those individuals who by choice or fortuitous incident devote themselves to special duties are brought together by occupation, by congeniality and by desire for mutual helpfulness and improvement. In this mutual attraction we find the genesis of all trade and professional organization. The aggregate is always stronger than the segregate. This unity of purpose and this conformity of effort become reprehensible only when autocratic, imperative and insolent. The assumption of superior virtues, the assertion of peculiar privileges and the interference with the rights of others are never to be advocated nor condoned.

Every honest effort to earn a living and a competency is worthy of equal praise, and therefore in dignity of effort there is no rank. The workman in the woods, the farmer in the fields, the artisan in the atelier and the mechanic in the mill have an equal claim to the dignity of labor with the preacher, the lawyer and the professor. There is no form of labor which is beneath the dignity of any man. Instead of being a curse, labor is the greatest blessing which Providence, fate or evolution has conferred on humanity. Tolstoi, one of the greatest living novelists, earns his living from the soil. Peter the Great was a carpenter and is said to have done much of the work in building the old palace at Peterhof. Louis XVI. was a locksmith. Washington was a farmer, Lincoln a rail-splitter, Grant a tanner, Garfield a canal boy. The natural and normal desire of men who have achieved greatness is for a piece of land where they can be in touch with the great mother of us all, the soil. To him who appreciates the true dignity of labor, no task is menial. The hands are made for toil as much as for fighting, and sweat is the most efficacious of all detergents. In derision on one occasion the Romans made Cato commissioner of sewers, but he discharged the duties of his menial office with such industry and benefit to the city that thereafter to be made commissioner of sewers was considered to be a distinguished honor.

So the true philosophy should teach us that our calling in life is a *cloacum magnum* which we are to administer, not with closed nostrils, but with open eyes and hands that do not recoil before thickened cuticle and stains.

He who is not proud of his profession is not worthy of it. This does not mean that his profession is any better than another, but when the heart is not in the work the head is sluggish and the hands are slow. Nor do I mean that a profession should not be regarded as a means of making a living. On the contrary, that is the first and chief end of any occupation. The number of persons who work alone for the love of it is exceedingly small. Perhaps there is only one profession where it is better that a man be rich, and that is the profession of politics. Making a living out of a public position is the most precarious of all professions, and there is no collection of dependent fossils which appeals so pathetically to general commiseration as that vast aggregation of exes which lingers near the cupola of the Capitol. The *functus officio* faster has fed so long at the public crib that he knows not the taste of other food nor the means of getting it. The last of his life is an eternal Lent on which no Easter morn of soothing satiety will ever rise.

In one short walk a few days ago I met one ex-senator and two ex-representatives, who a few years ago were farming patronage and feasting on lobster a la Newburg at Chamberlin's, who are now seeking to be attorneys for the holders of claims that live only in the hope that a far-off indulgent future will no longer know their worthlessness. Hungry are the looks of these men, with jaws cavernous as those of Cassius, and sad warnings of the fate of a statesman out of a job. A profession, therefore, should offer some guaranty of a livelihood dependent on merit and industry, and not upon the whim of a capricious public.

It is not my purpose to-night to discuss chemistry as a living-provider. Often young men come to me and ask my advice in regard to choosing a profession. They come often with a strong inclination to chemistry and want to know what I think of the prospects for success. If they have already studied chemistry I invariably ask: Have you a taste for chemistry? Do you love chemical studies? If they do not know, or if the answers are indefinite or evasive, my advice is always: "Stay out." But especially is this so if they propose to study chemistry as a profession because it is an easy road to wealth. Alas! the paths of chemistry seldom lead to "easy street." True it is, you rarely see the chemist begging bread. Perhaps he knows too well of what it is composed. The chemist tramp, too, is a kind of a *rara avis in terris cygno simillima nigra*. The chemist may be able to change phosphorus into arsenic by oxidizing it in the presence of ammonia, but even so distinguished a man as Carey Lea could only make silver yellow, and further than this scientific transmutations have not extended. Fortunes have been made by a few. A happy discovery in metallurgy or in manufacturing processes has often brought a modest fortune to the inventor, but most of the roads leading from the Patent Office end in the cemetery of hopes at first vigorous from the pliant pabulum labeled: "Having now described my invention what I claim is," etc., "substantially as set forth." The parchments with the flaming seals that protect you in the sole usufruct of your genius for a period of 17 years serve most frequently as fitting cerements for the deceased. If the chemist be a teacher or employed at a salary the prospect for a competence is not much better. At best these stipends are not very large. In a manufacturing enterprise the chemist often becomes the manager, and in this case he can put by something for "a rainy day." If a professor, he sometimes gets to be the president of the college, provided his theology is untainted. But Universities of Chicago are not found in every academic grove. Most of our institutes of higher learning are chronically impecunious, and even the professional chair is not upholstered with a cushion which would tempt the expectant Croesus.

In general, then, it must be admitted that whatever of dignity is due the profession of chemistry is not attributable to its tendency to wealth.

I am not of that school which despises wealth, nor yet of the cult that loves it. Poverty, doubtless, has its uses in evolution and molding of character. Wealth often corrupts youth and makes of manhood but a purveyor of vice. But poverty also invites crime, and is not the most efficient preservative of virtue. A modest competence, possibly, is the ideal state, best suited to highest development and greatest usefulness. It is not always dignified to be in debt. For this reason I should like to see the influence of this great organization whose foundation we celebrate to-night exerted to secure better pay and more permanent employment for its members. I know this seems sordid and mercenary, but we must not always live in the clouds. The cerulean atmosphere will be more gratefully stimulating and its views be more thoroughly appreciated if we manage somehow to keep our feet well braced on terra firma. To him who cannot swim things begin to feel a little queer when the advancing tide leaves him touching only a little flowing sand with the tips of his toes. Good and steady pay, therefore, to its devotees is no small contribution to the dignity of chemistry.

The pursuit of science is nothing else than an effort to know something of the constitution of the natural world. That knowledge is not derived from an ingenious system of vain imaginings, but is secured by a study of nature herself.

"To him who in the love of nature holds communion with her visible forms she speaks a various language," sang one of our great poets at the age of 17. Had he lived until he was 100 and grown in wisdom every year he could not have touched a truer note. The language which nature speaks to the chemist is a description of the ultimate nature of things. It is to the chemist that nature teaches the alphabet of human knowledge. In this sense the chemist comes nearer than any other to first principles. As we grow in knowledge we sometimes forget our small beginnings. And so it sometimes seems to me that our professional brethren of other schools are prone to despise the day of little things. Atoms and molecules are too small to cut much of a figure in the economy of nature, think some. But it is no true mark of greatness for the macrocosm to forget the microcosm. A megatherium is not the "whole show." It is true that in some respects chemical achievements appeal least of all scientific accomplishments to the popular attention. The isolation of krypton does not have half the interest for the public that attaches to the discovery of a new bug, especially if it have domestic tastes. In fact, all the biological sciences, with the possible exception of physics, find a readier and more appreciative public than those which deal with things lifeless and for the most part incomprehensible to the layman. This truth is uttered in no complaining mood, but only to explain why Davy is not as well known as Darwin, nor Hoffman as Haeckel. It is when chemical studies and discoveries come directly into contact with life that they lead to recognition, as in the case of Pasteur, whose great genius is recognized the world over, perhaps more generally than that of any other scientific man has ever been. But it is not alone for public applause that life is worth living, and the dignity of our science suffers no depreciation because of its apparent remoteness from human interest. I say apparent, because I do not believe that any other science has in reality any nearer bearing on human welfare than chemistry. Think for a moment how many of our industries that lie at the foundation of wealth and progress are based directly on chemistry. Think of the many others that are intimately related to it indirectly. If the clock of political progress and liberty were turned back 50 years by the battle of Waterloo, think of the loss to humanity should such a disaster befall the hosts of chemistry. Bourbonism is the natural foe of human progress, and unhappily the world is still full of anti-scientific Bourbons.

Whatever may be the branch of the profession which the chemist may pursue, he should not be indifferent to feelings of justifiable pride which come to him when he realizes all that our science has done for humanity. The disciples of evolution may have attached some opprobrium to the epithet, but the chemist is the "connecting link" between the world of matter and mankind. We stand the nearest of all our brethren to the ultimate constitution of things, so near, in fact, that we almost tremble at the thought that by some subtle synthesis we may strike the spark of organic life. Of one thing at least we may feel sure. We know best of all our brethren the environment of development and growth. We may never create an environment which will make autogenesis possible, but we surely can soften some of the harder conditions of existence. To be so near the first forms of life, to be so nearly in touch with the ultimate secrets of nature, are facts which show some of the principal elements of the dignity of chemistry.

No man can lay claim to the term scientific who does not reverence the truth. That is the first element of a scientific mind. The truest proof of a reverence for the truth is a willingness to be convinced. In the times of Cromwell the truth was supposed to be simply the dogmas of the creed, which led Hudibras to say:

> "Convince a man against his will,
> He'll hold the same opinion still,
> And prove his doctrine orthodox
> By apostolic blows and knocks."

The most difficult mental attitude, which the scientific man has to contend with in his struggle for the truth, is bias. We inherit, in a measure, certain notions of things and of life. This natural inheritance is strengthened by the earlier teachings of childhood, so when we reach the age of maturity we have formed certain opinions, we are endowed with certain habits of thought which tend to dominate our mental attitude. Happily, most of these habits and most of these inheritances are sound, but now and then we find one which is clearly opposed to the conditions of existence as science reveals them. How difficult in this case to let go the old notion; how hard to bring one's self into an attitude to receive the truth! Perhaps it is only a species of conservatism which leads man to hold on to that which he has, and in this sense a certain difficulty of conviction is a guaranty of stability of thought and of social, economic and political conditions. In other words, we should heed the warning in the Bible and not be swayed by every "wind of doctrine." The tendency to too eagerly accept is more reprehensible than tardiness of belief. We have all seen wave after wave of illogical belief sweep over the country, and no difference how absurd a theory may be or how impossible a course of action which is marked out, it finds plenty of adherents. This instability tends to render all the conditions of natural growth and development precarious. The scientific man must be on his guard against being buncoed by any plausible or specious doctrine, as well as to keep his mind open for the acceptance of the truth. Here is where judgment comes into play, and not only should the scientific mind be open to conviction, but it should also be controlled by a sober and discreet judgment which can discriminate between the true and the false in evidence. But when soberly considered certain facts are brought home with an overwhelming evidence of truthfulness, the results of this evidence should be accepted, no matter how contrary they may be to our preconceived notions. Perhaps the greatest offense in this direction which the scientific man commits is a distortion of evidence to suit the case. By a slight inclination this way or that from the true point of direction an observed fact may be made to support this or that theory or condition. I am far from belittling the value of theory. When formed on substantial evidence and with a becoming ingenuity it is a valuable aid in the discovery of further truth, but a theory should never be a fetich to be reverenced and worshiped with the blind devotion of the religious devotee. There is nothing sacred about the theory. It is only a valuable tool to be cast aside when a better or more effective one is at hand. The dignity of our profession, therefore, has been strengthened and increased by the habit of the chemical mind of accepting the dicta which experimental evidence has provided. Detracting somewhat, however, from this dignity has been the fact that certain contentions have arisen in our profession over the interpretation of ascertained phenomena. Chemists may agree upon the character of certain phenomena which are presented, but construe them differently, and often with acrimony. A scientific discussion should be conducted with all the dignity of a scientific dissertation, and the honest differences between chemists should never be allowed to degenerate into personalities or innuendo. There is no excuse whatever for speaking slightingly of the honesty or ability of a brother chemist who may happen to differ from you in his opinion of phenomena. Envy, backbiting, slander and scandal have no place in the chemical profession. I believe everyone will admit that there has been less of it in the profession of chemistry than in almost any other. We know to what extent the personal quarrels among many scientific men have been carried in this country, and we are glad to say that there is no instance in which these quarrels between chemists have come into our organization to influence our action and mold our policies or to cause the growth of faction and the promotion of feuds.

There is enough for everyone to do in this country without wasting his energies with envy of the accomplishment of others. About the most unprofitable occupation into which a man can fall is to complain of a lack of appreciation. It is doubtless true that in many cases the worthy man is cheated of his dues and the unworthy receives a reward out of all proportion to his services. These are accidents, which are due to the imperfections of human nature, and not to any peculiarity of scientific pursuits. There should be room for the philosophy of life in chemical science as in every other. The sensible way is to accept what happens, and not to degenerate into a kicker or the carrier of a club. The chips which are found on the shoulders of our associates are usually magnifications of the motes in our own eyes, and not due to the deposition of any really ligneous material upon the clavicle of our supposed enemy. We have plenty to do in this world without going about knocking off hypothetical chips. I have the profoundest sympathy for the man with a just grievance, and I know how many have them, but there is no greater nuisance than this same man with this same just grievance. The man who shuts his mouth, compresses his lips and bears the pain and humiliation without a sign is the one who wins our admiration in the end and often turns disaster into good.

With a proper appreciation of the dignity of our profession, we will therefore do our work as well as we can and be glad of the greater success of our professional brethren, and not find in it a cause of sorrow and dejection. Every man who succeeds in chemistry

* An address delivered before the American Chemical Society, April 12, 1901, on the occasion of the celebration of the 25th anniversary of the founding of the Society.—From Science.

does a work to elevate our profession and to help us all, and therefore, even from a selfish motive, we should be glad of his achievements. I realize how hard it is to see others preferred when we feel convinced that we should have had it, and yet I must be allowed to praise the courage of the man who with a smile on his face and a true feeling of well-wishing in his heart can congratulate the more successful man not with hypocritical words, but with a real sentiment of satisfaction.

There is one special way in which I think our great organization can do much to elevate the dignity of chemical science. I have spoken of the fact that chemistry does not appeal directly to the public imagination, and for this reason many of our best people do not have a true appreciation of the value of chemical services. An honorable and praiseworthy part of our profession is the rendering of professional services of a chemico-technical nature to the great industries of the world. Too often the promoters of these industries, the men with the money, the men on the boards of directors, and the stockholders, do not appreciate the real value of the services they ask for. A great corporation is perfectly willing to pay a great lawyer $10,000, $15,000 or even $50,000 for professional services, whereas if a chemical expert should ask $1,000 it would produce a kind of corporative hysteria or nervous prostration, while, in point of fact, the technical services demanded would probably be of far greater financial utility than the legal services so much more liberally paid for.

There has been a tendency among some of our profession to foster this spirit of contempt for the value of chemical services of a professional nature, not intentionally, I am glad to say, but because of a feeling, which I can hardly describe, that it is not dignified for a chemist to sell his services for money. The falseness of this position, it seems to me, has been fully set forth in the earlier part of this address, and I believe that every right-minded person will admit that it is not derogatory to dignity to receive pay. Otherwise, I should think that we should cast dignity to the winds and look out for the "main chance." In my opinion, it is just as honorable and worthy to give professional advice to a great industry as it is to discover an unknown element. In our society we should have far more *esprit de corps*, more regard for the rights and privileges of each other, and a better understanding of the ethics of our profession. It is true that we now act upon the principle that it is dishonorable to take an investigation out of the hands of a brother who has once commenced it, without his permission, or in any way to trespass upon the fields which he has pre-empted. In like manner we have learned that it is dishonorable to underbid a professional brother in offering our professional services. It seems to me that the society can do a great good toward promoting the dignity of our profession in this way by establishing not a hard and fast schedule of prices for professional services, but by bringing closer together our members who give these services so they may have a better understanding of the rights and privileges of each other. Other professions do this, especially the medical, and great benefit would be derived from a better understanding in regard to these matters.

Especially is this true from the effect it would have upon the public at large who, seeing a profession stand together and in a dignified manner demand what is right and just, would better appreciate the value of the services which they often hope to get for the very smallest possible consideration.

Perhaps the bitterest criticism to which the chemist has been subjected has grown out of his services as expert before the courts. Here we often have the spectacle of two men, under oath, one in affirmation, one in negation. It is only natural that the expert should favor his client, but that favor should never go so far as to impugn the truth. When there is room for disagreement, I can see no impropriety in the chemist supporting with all his ability the side that employs him. He is not hired to discuss the whole problem in all its aspects, but to develop those points which make for the benefit of his employer. We cast no reflection on the honesty of the lawyer who defends, nor should we on the rectitude of the witness who testifies. But no worthy chemist will deliberately undertake to support a falsehood. Whatever of viciousness may attach to expert evidence is the fault of the system rather than of the witness. We all admit that it would be far better for the court to employ the expert, and not the plaintiff or defendant. But until that change has been made, the chemist is undoubtedly right in making out the best case possible for his client, provided he distorts no facts.

How far he can go with patent medicines, nostrums and secret preparations is another story. The dignity of our profession forbids any taint of humbug or quackery. This field, therefore, seems to be absolutely closed for professional purposes.

I would not have our Society become a trades union, and especially would I be sorry to see it exercise the tyranny which such unions often manifest, but I would like to see a better understanding established in matters of this kind, both for the sake of our members and for the benefit of the public at large.

The dignity of the profession of chemistry is illustrated in a striking way by the active participation which it exercises in many of the greater walks of life. I have not time here to go into statistics and show the relative number of chemists employed in the industries as compared with members of other scientific professions. We will admit without such an array of figures that there is no other scientific profession, with the possible exception of physics, which begins to be so numerously represented in the great industries as the science of chemistry, and even in the case of physics, aside from the electrical industries and those of a purely engineering character, the physicists engaged in the active industries are not numerous.

When it comes to mining engineering, we find that the engineer himself must be a chemist in order to be fully able to discharge the duties of his profession. In so far as statistics are concerned, I will content myself with a few citations showing the preponderance of chemical employés in the great scientific agricultural industries of our country.

In a study of the impress which chemical research has made upon agriculture, there has been no factor during the past twenty years which can compare with the work of the agricultural experiment stations of the United States. Richly endowed as they are by the General Government, they have had every opportunity to secure the best results for practical agriculture.

In this work chemical science has played a very important part in the furthering of agricultural prosperity. Of the forty-nine directors of the stations at the present time, twenty were professional chemists at the time of their appointment. The selection of so many professional chemists was no mere chance, but evidently had some relation to the dominant position which the science of chemistry holds to the promotion of agricultural chemical research. The list of directors of the agricultural experiment stations of Germany shows the same condition of affairs.

The great influence of chemistry on the agricultural experiment stations of this country is not measured alone by the number of professional chemists which is found in the directorates, but also by a comparison of this number with that of other scientific men holding similar positions. Very few of the other sciences are represented among the directors of stations, and no one of them can compare in its number of representatives to the science of chemistry. Among the working forces of the stations chemists also predominate. There are twice as many chemists employed in the stations as there are men engaged in any other professional scientific work. Statistics show that the number of chemists employed in the agricultural experiment stations of the United States is one hundred and fifty-seven, while the number of botanists is fifty and the number of entomologists forty-two. The number of employés belonging to other branches of science is very much less than that of the botanists and entomologists, and the total number of scientific men employed in all other branches of scientific work in the stations does not greatly exceed, even if it be equal to, the number of those employed in chemical research alone.

While dwelling upon the predominance of professional chemists in the directorates and upon the staffs of the experiment stations, it seems eminently proper to mention here in a special manner some of the earlier eminent chemists who have contributed so much to the value of chemical research in our agricultural colleges and experiment stations. Among these must be mentioned Prof. F. H. Storer, of the Bussey Institute (Massachusetts), who first began the regular publication of a bulletin recording the work of the school and station, which has "set the step to which the bulletins from many other stations are still marching." The bulletins of the Bussey Institute describing original research work on agricultural subjects have proved of the highest benefit to agriculture. Prof. Storer's work, entitled "Chemistry in Some of its Relations to Agriculture," the first edition of which was published in 1887, has had a marked effect upon agriculture in this country.

As early as 1846 Yale University, then called Yale College, appointed a professor of agricultural chemistry. This was John Pitkin Norton, who had devoted himself to the study of scientific agriculture both in this country and in Europe, especially with the celebrated Liebig. He brought to his position a ripe knowledge and wisely directed enthusiasm for agriculture, which he used with the greatest profit in its service. In 1855 Samuel William Johnson was appointed instructor in agricultural and analytical chemistry, and soon after full professor. Perhaps no one ever succeeded more fully in popularizing scientific agriculture than Prof. Johnson. His two books, "How Plants Feed" and "How Plants Grow," the first editions of which were published in 1868 and 1870, respectively, have been kept abreast of modern progress in successive editions, and are still used as standard text-books and as authorities on the practical relation of chemistry to agriculture.

In the University of California, the work of Prof. E. W. Hilgard must be mentioned as being of fundamental importance in the development of the relation of chemistry to agriculture in this country. Prof. Hilgard, in his classical work on soils, has placed himself in the front rank of investigators on this subject, not only in this country, but in the world, and his achievements have been recognized both by his countrymen and by the most celebrated societies of Europe. A knowledge of the soil and its relation to plant growth constitutes one of the fundamental principles of agricultural chemistry, and the researches of Prof. Hilgard in this line have done much to place agriculture in the United States on a strictly scientific basis.

At Cornell, even before her doors were open to students, a professorship in agricultural chemistry was established. Prof. G. C. Caldwell was appointed to fill this position, and he has done so with distinction to himself and to the university, and with the greatest benefit to agriculture. One of the most important services in connection with Prof. Caldwell's labors at Cornell was the publication of his work on agricultural chemical analysis in 1869. At that time no work of a similar nature existed in the English language, and Prof. Caldwell's book was a veritable boon to students in agricultural science.

This brief reference to the contributions of some of the earlier workers in agricultural chemical science in this country would not be complete without mention of the labors of Prof. C. A. Goessmann, of the Massachusetts Agricultural College.

It is not possible in the space assigned to this address to even name the more prominent later workers.

A national epoch in agricultural education in this country began with the passage of the Morrill Act, in 1862, establishing and endowing colleges where agriculture should be one of the principal branches in which instruction is given. An additional impetus was given to this great work in 1887 by the passage of the Hatch Act, establishing agricultural experiment stations in the several States. The organization list of the agricultural colleges of the United States now shows the great number of men working in lines of agricultural chemistry. This most remarkable evolution of agricultural education has taken place practically within the last thirty years, and there is no country which can now be compared with the United States in the munificence of the endowment for agricultural chemical research or in the vast amount of research and experimental work conducted in these lines.

Another way in which our profession has influenced higher education in this country is found in the large number of chemists who have been called to preside over our higher institutions of learning. Of the leading institutions in this country, Harvard University, Lehigh University, the University of North Carolina, the University of Tennessee and Purdue University are presided over by professional chemists, or rather, I should say, by those who before elevation to the presidential rank were professional chemists. I doubt if any other branch of science can show so many college and university presidents as our own. It is certainly not a mere accident that in the breaking away from the old scholastic habit of placing ministers of the gospel over institutions of learning, chemistry has received so marked a favor. In fact, the pursuits of chemical science, it seems to me, tend more than other scientific occupations to broaden the mind and to bring it in contact with all the varied industries and forces of active life. It is true that other branches of science have their economic aspects, and we do not by any means desire to minimize that important relation, but they do not come so generally into contact with human affairs. While they appeal in the nature of their services more to the public imagination, when it comes to real practice they do not have that influence which our own science possesses.

I am far from saying that the pursuit of chemical studies tends, in any peculiar way, to develop administrative ability, and hence it cannot be in this collateral way that so many of our brethren have reached these higher places of administrative effort.

While we do not claim that chemical science holds in any way the same dominant position in didactics that it does in agriculture, we do find, even in the smaller institutions of higher learning, that, as a rule, chemical science is taught more thoroughly and more effectively than other branches. The consideration of these facts, if prominently brought before the attention of the public would certainly do much to increase the estimation in which our profession is held.

The above only illustrates in one industry the dominant influence of chemical research, and in so far as science comes into direct contact with the industries of the world, it is evident that in almost every one chemistry occupies the predominant position. This well-recognized fact is a firm basis for the substantial claims of the dignity of our profession.

There is one point, however, in which it seems to me we are much at fault, and that is in the fact that the chemists of this country seem to have taken but little interest in the science of civics. We are too prone to regard politics as a profession beneath the dignity of a scientific man, and yet we must admit that the organization of the body politic for the public good is the highest work to which a man can devote himself. In other words, real politics is the most useful and most honorable of professions. The trouble here in this country is that politics becomes too much of a profession. In other words, it becomes a source of revenue or of sole revenue. How much better it would be if men who have reached success and competence in other professions, without abandoning these in their maturer years, would devote a portion of their time to the public good. In Europe this is commonly the case, and we are all familiar with the names of eminent scientific men who have become celebrated also as leaders in political life. In Germany, we recall the name of Virchow, who, for more than thirty years, has been a member of the National Legislature, and of Mommsen, the great historian, who has taken an active part in politics. In Italy, one of the honorary members of our society, Cannizaro, is a senator and vice-president of that body. In France, Berthelot is a life senator and has been minister of foreign affairs. In England, Roscoe has been a member of Parliament, and Faraday and Humphry Davy and other scientific men were active in public affairs. In our country, I believe, only one member of the Chemical Society has ever become a member of the National Legislature, and this was due to a fortuitous combination of most incompatible elements, namely, a union of democracy and prohibition.

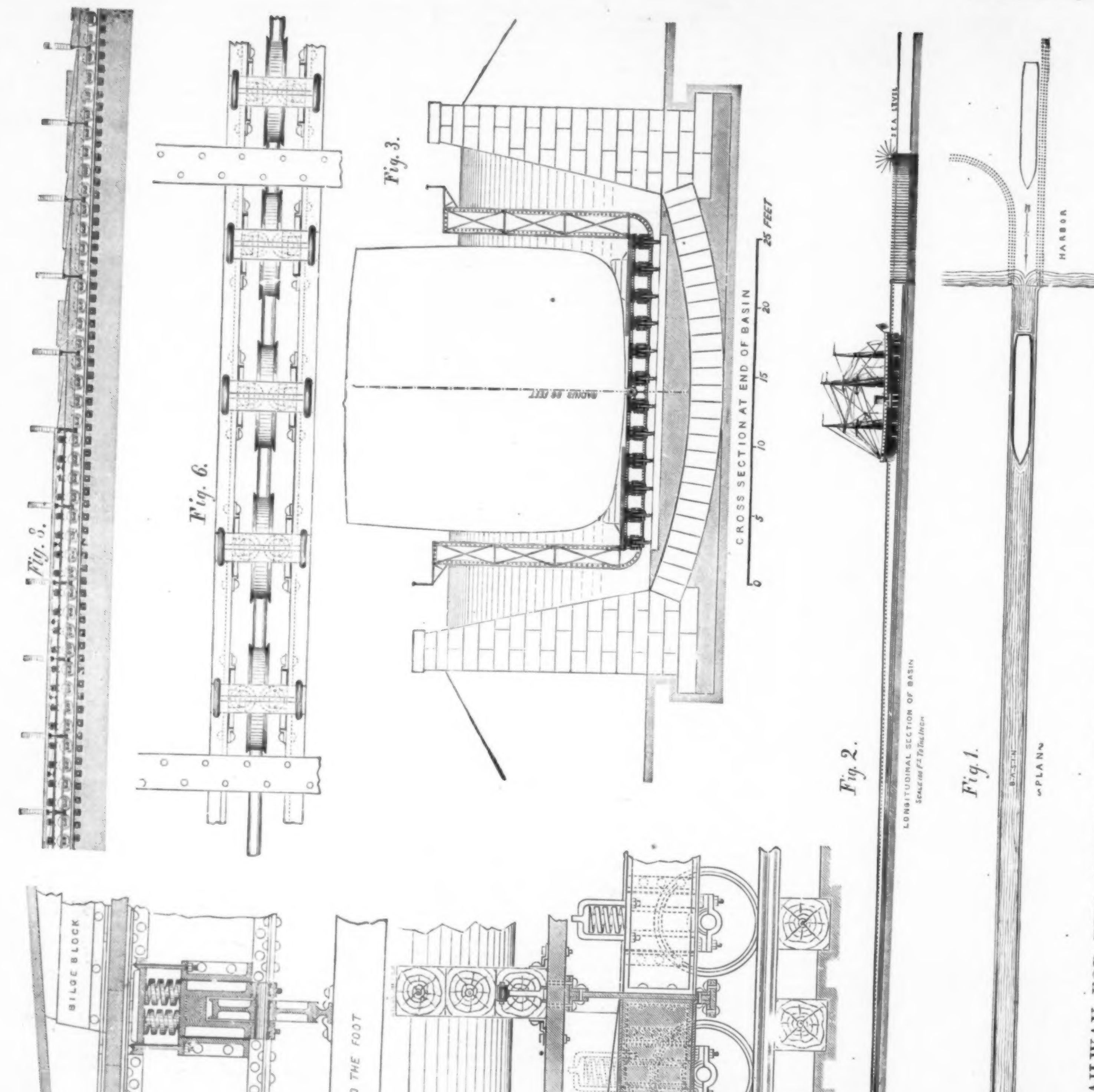
I think we should all strive to discourage this sentiment, which is so prevalent, that politics is a dirty pool and that men of science should keep out of it. When you have reached competence and distinction in your profession what better service to which to apply your leisure hours than the study of the public weal? There are so many ways in which science can be utilized in political and civic affairs. The conservation of the public health, the prevention of epidemics and contagious diseases, the control of the water supply of cities, the disposal of the refuse of cities, the study of dangerous and fraudulent counterfeits of foods, are all matters affecting directly the public health and the public welfare. To become interested in these matters would be to more actively participate in public affairs, and it seems to me it is an ambition which every scientific man might well entertain, not only to become eminent in his profession, but also to devote a portion of his more mature life to the study of the public welfare and the active participation in those political relations of life which will enable him to become more useful to humanity.

May we not then expect to see the day when our State and National Legislatures shall not be considered as properly organized until they have among them members representative of the great body of American chemists?

On April 12, 1976, will be celebrated the centenary of our society and shortly thereafter the bicentennial of our national independence. May I drop for a moment the rôle of chemist and assume that of prophet? Our country will have then about 225,000,000 inhabitants. Our foreign export trade will amount to more than $500,000,000 annually. The revenues and expenditures of our government will each reach annually the sum of $4,000,000,000.

The average yield of wheat in the United States will be nearly 25 bushels per acre, and the average yield of other field crops proportionately greater than now.

Diversified manufacturing industries will flourish in every part of the country, thus distributing population and encouraging agriculture. The product of a day's labor will be double that of to-day, thanks to



MR. EADS' GREAT SHIP RAILWAY FOR THE AMERICAN ISTHMUS.—DETAILS OF CONSTRUCTION.

new processes, improved machinery and greater skill. The condition of the artisan and the laborer will be greatly ameliorated, and the principles of the trust, which now help chiefly the capitalist, will be extended to include the working man as well. The laborer will not only have a larger daily wage, but will also share in the legitimate profits of the business.

The advancement of chemical science will not only make the fields more productive and more easily tilled, but will also teach how their products can be more economically and easily consumed. Good roads will lead everywhere and the horse be relegated to the museum and the stable of the sportsman. New sources of energy will take the place of coal and gas, and this energy will come from the winds and the rains. The sun directly and indirectly will monopolize the power of the country, working through evaporation and precipitation and by means of electricity or some more useful force.

By a general comprehension of the principles of nutrition, food will be more wholesome and more potent. The general acceptance of the principles of hygiene will make the average life of man longer and his usefulness more fruitful. Man will not only live longer, but he will be happier and practically free from the threats of enzymic, contagious and epidemic diseases. When this Society meets on that founders' day, the membership will be nearly 10,000 and its organization will reach to all quarters of our imperial country. The number of those who to-day are members and who shall live to 1976 is not large, possibly *nil*, but many who are infants to-day will be the revered old men on that centennial occasion. The orator who will address you on that day is perhaps not yet born. I hope he will take for his theme, the "relation of chemical work to the advancement of mankind in the past century." He will find in the development of some of the thoughts which I have tried to bring to your attention to-night the most potent causes that make for the good of man. In such a light as he can shed on life and its conditions the coming man will be able to see the true dignity of chemistry.

AN ISTHMIAN SHIP RAILWAY.

To the Editor of the SCIENTIFIC AMERICAN:

Why shall it be Panama or Nicaragua? You are entitled to great credit for presenting the facts so clearly, and if there must be a canal to secure interoceanic communication over the American isthmus, it is clear to my mind the Panama is by far the more practical scheme of the two.

But why a canal at all? Is not the Tehuantepec ship-railway scheme more desirable from every point of view? Ignorance regarding its advantages should be removed, and prejudice against its practicability should be overcome by a presentation of facts. Such drawings and engravings as you may prepare to illustrate the scheme may convince so many that it is the cheapest, best, and quickest solution of the problem of connection of ocean with ocean, that Congress will immediately appropriate at least one-fourth of the sum that was spent on account of Panama and Nicaragua to have a survey of Tehuantepec made for a ship railway. The present Isthmian Commission, being well organized, might be directed to make the survey, plans and estimates, and could make a very complete report by the time Congress meets again in December.

The Tehuantepec route saves 900 miles over the Panama route to vessels bound from New York to San Francisco. Vessels bound from New Orleans to San Francisco would save 1,580 miles by taking the Tehuantepec rather than the Panama route. Sailing vessels—and they will be built more than ever—will find the trade winds more favorable at Tehuantepec than at Nicaragua or Panama, besides there will be no towing fee on the ship railway. The Tehuantepec isthmus is more healthful than either Panama or Nicaragua, and there is less rainfall to interfere with labor or to cause engineering difficulties. The Tehuantepec railway from Coatzacoalcos on the Atlantic to Salina Cruz on the Pacific is about completed, and being at no point over ten miles from the probable location of the ship railway, will greatly facilitate its construction.

A ship railway can be built in half the time required to build either canal. Even with a capacity to transport ships of 40,000 tons gross weight, 90 feet beam and 800 feet long, the cost will not exceed $100,000,000. No ship has yet been built that large, but in providing for such vessels, which may be built within the next five years, a double-track line is provided for over 50 per cent of the ocean's tonnage.

A comparatively inexpensive improvement of the Coatzacoalcos River will give it a channel 40 feet deep and 500 feet or more wide for 20 to 30 miles from its mouth. At that distance from the Atlantic pneumatic balanced lifts are designed with a rise of 50 feet or more. From these lifts the rails will lead 130 to 140 miles to similar lifts at Salina Cruz, the Pacific terminal.

It is not necessary that an absolutely straight track be provided, as curves of 10 miles' radius will permit the location to avoid excessive cuts or fills, and provision is made to allow the wheels to adjust themselves to such curves, the middle ordinate of which for a 750-foot car would be less than 2 inches.

A cradle car 750 feet long would carry an 800-foot ship, a slight overhang being allowed at each end. If made to carry a 40,000-ton ship it ought not, with all its appliances for holding the ship safely and firmly, weigh over 20,000 tons. The maximum weight to be lifted and transported would then be 120,000,000 pounds. To operate the lift the pneumatic caissons need never to have a pressure over 15 pounds per square inch, and a failure of any part of the air mechanism could only at the worst result in an easy settling down to the water level and but slight delay to make any repair necessary to effect a successful lift.

The wheels for the car are 2 feet in diameter and spaced 3 feet from center to center, making 250 wheels to each line of rails under the 750-foot car. As there are 24 lines of rails under such a car, it would have a total of 6,000 wheels. The load per wheel would be 20,000 pounds, though double that could be carried with entire safety. The wheels of the 100,000-pound capacity pressed steel cars now used on leading railroads carry about 18,000 pounds each over rougher roads at much higher speed than would ever be experienced on a ship railway.

It is proposed to haul such cars by steam locomotives, though it may be found more economical to use electric locomotives, the current to supply them being generated at several available water powers that exist on the isthmus. Steam locomotives specially designed with saddle tanks for water and for fuel oil (which can be secured cheaply and abundantly in California and Texas) can be made to exert a tractive force of 60,000 pounds. The pull required to carry the 120,000,000-pound car and load up a grade of 20 feet per mile at the rate of six to ten miles per hour is about 1,000,000 pounds. Eighteen locomotives, three to each of the six tracks, two pulling as a double header, and one pushing, would do the work. Besides one or two cars to span the entire six tracks, others in larger numbers according to probable demand for them will be supplied to span two, three, four or five tracks. There will probably be more cars to cover three tracks, measuring 58 feet in width and adapted to carrying ships of 40 feet beam, than of all other sizes. The ship railway as described is in effect a double-track road for the 58-foot wide cars.

[We publish herewith the original design of Mr. Eads for a ship railway.—ED.]

Transfer tables 1,000 feet long are provided at intervals of 20 or 25 miles, where ample side tracks will be provided. As a ship on a cradle car is practically drydocked, it is expected that not a few vessels will be sidetracked to have their hulls cleaned or to have other repairs made. The transfer tables are traveled at right angles to the main tracks and will preferably be operated by electricity.

The slope from the summit to the Pacific being more abrupt than on the Atlantic side, it may be found desirable to place one or two lifts at suitable locations to keep the grades down to 20 feet per mile and to maintain a more direct alinement. A ship railway survey may show that no lifts are required except at the terminals. Prof. E. A. Fuertes, of Cornell University, who made a canal survey of Tehuantepec in 1871, in a letter to Capt. Eads, relative to the ship-railway scheme, says:

"I can assure you, upon knowledge of every inch of the ground, that you will find no difficulty about curves, grades or bridges. The ascent of the Atlantic slope will offer no more difficulties than the Hudson River Railroad; and on the Pacific side, either one of the three passes in the neighborhood of Tarifa or Chivela will allow of no steeper grade than 25 to 35 feet per mile to bring you down to the Pacific plains. The ground offers you 50 miles to get down in, and as much more as you may wish by following the hillside. All the bridges required will be of comparatively short spans. You will find very little anxious work on either terminal harbor, very little tentative work being required, and permanence without ulterior complications will reward almost any kind of attack. The drainage of the works, building materials, abundant native labor, a remarkably healthy climate, etc., will be all you may desire."

There are many reasons why Americans should build a ship railway rather than a canal, and prominent among them is that rails, locomotives, structural steel, machinery and various supplies will all be of American manufacture.

The six lines of road are constructed on ties 12 feet in length. The lines are spaced 11 feet from end to end of ties to afford ample room in which to remove and insert ties, to place hand cars and damaged wheels. Each line of ties supports four rails, the gage of the inner rails being the standard 4 feet 8½ inches. The outer rails are spaced 15 inches from center to center from the inner rails. Wheels are in pairs on a short axle. The pedestals holding the journal boxes and the journal springs over them and the adjusting screws over the springs are detachable, or arranged to swing up or to one side to permit imperfect wheels or springs to be quickly replaced with perfect ones. The pedestals for each set of eight wheels are secured to a stiffened flat truck frame having roller bearings between them and the cross beams of the cradle car. Each truck frame has its kingbolt, allowing the wheels to adjust themselves to curves or imperfect alinement. The kingbolts are allowed a lateral movement of 2 or 3 inches on either side of a normal position, springs being provided on either side to maintain the normal position when no side pressure is exerted. A complete outfit of air-brakes is provided for each cradle car. The equivalent of 1,800 miles of single-track railway is involved in this ship-railway scheme, and the steel rails for it, 120-pound rails, at $30 per ton, would cost $10,000,000.

The outlines given above are sufficient to convince most people that the scheme is a practical one. Enough details have been given to show that thought has been given to every feature, and a satisfactory solution found for every minor difficulty. An exact location is needed to make an accurate estimate of cost. When a careful survey is made and estimates are based on thorough investigation, and report of the same is made, then, and not until then, can Congress be justified in authorizing the construction of either a ship railway or a canal. A. E. CHEFF.

Washington, D. C., January 28, 1902.

HOW TO CONSTRUCT AN EFFICIENT WIRELESS TELEGRAPH APPARATUS AT A SMALL COST.

By A. FREDERICK COLLINS.

SINCE the practical introduction of wireless telegraphy in 1896, great progress has been made, not only in spanning great distances, but in syntonizing or tuning a certain receiver to respond to a given transmitter.

To follow up the intricacies of wireless telegraphy there can be no better method than to build an apparatus and make the additions from time to time as they are published in the SCIENTIFIC AMERICAN. To telegraph a mile or so without wires by what is known as the etheric wave or Hertzian wave system is not difficult; indeed, the apparatus required is but little more complicated than the ordinary Morse telegraph, and is so simple that the reader need have no difficulty in comprehending every detail; if, on the other hand, one wishes to work out the theory involved, it becomes such a difficult task that the master physicists have yet to solve it. It is the practical and not the theoretical side of wireless telegraphy we have to deal with here.

The instrument that sends out the waves through space is termed the transmitter, and this I shall first describe. It consists of an ordinary induction or Ruhmkorff coil (see Fig. 1) giving a half-inch spark between the secondary terminals or brass balls. Such a coil can be purchased from dealers in electrical supplies for about $6. A larger-sized coil may, of course, be used, and to better advantage, but the cost increases very rapidly as the size of the spark increases; a half-inch spark coil will give very good results for a fourth to half a mile over water, and the writer has transmitted messages a mile over this sized coil.

Having purchased the coil, it will be found necessary to supply the oscillators, as the brass balls are termed, since coils of the smaller size do not include them. The brass balls should be half an inch in diameter and solid; they may be adjusted to the binding posts of the secondary terminals by brass wires, as shown in the diagrammatic view, Fig. 2. It will require two cells of Bunsen battery to operate the coil, or three cells of Grenet or bichromate of potash battery will operate it nicely. An ordinary Morse telegraphic key is connected in series with the battery and induction coil, as shown in the diagram. Now when the key, 4, is pressed down, the circuit will be opened and closed alternately—like an electric bell—by the interrupter, 2, and a miniature flash of lightning breaks through the insulating air-gap between the balls or oscillators, 5, and this spark or disruptive discharge sends out the etheric waves into space in every direction to a very great distance.

The oscillators should be finally adjusted so that not more than an eighth of an inch air-gap separates them. The reason the distance between them is cut down from a half to an eighth of an inch is because in wireless telegraphy it has been found that a "fat" spark emits waves of greater intensity than a long, attenuated one. The balls are termed oscillators, since, when the electric pressure at the balls becomes great enough to break down the air between them, the electric wave oscillates or vibrates very much as a string of a musical instrument oscillates when struck; in other words, it vibrates back and forth, very strongly at first, growing lesser until it ceases altogether.

The coil and key may be mounted on a base of wood 8 inches wide by 17 inches long and ¾ inch thick (Fig. 1). This, with the battery, constitutes the wireless transmitter complete, with the exception of an aerial wire leading upward to a mast 30 or 40 feet high, or the wire may be suspended outside a building. At the upper end of the wire a copper plate 12 inches square should be soldered; this is the radiator, and sends out the waves into space; another wire, 8, leading from the instrument is connected with a second copper plate, 9, buried in the earth. The wires are

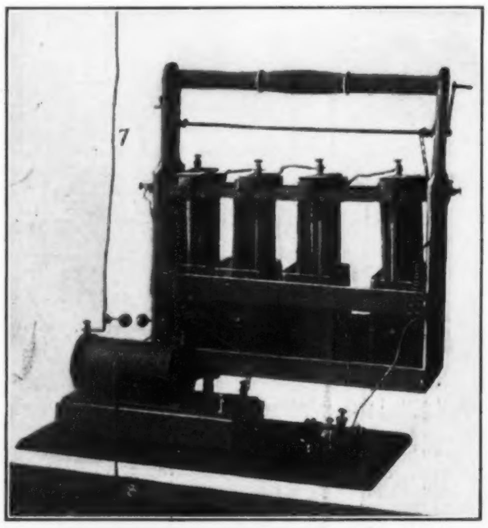


FIG. 1.—CHEAP RUHMKORFF COIL GIVING ½-INCH SPARK.

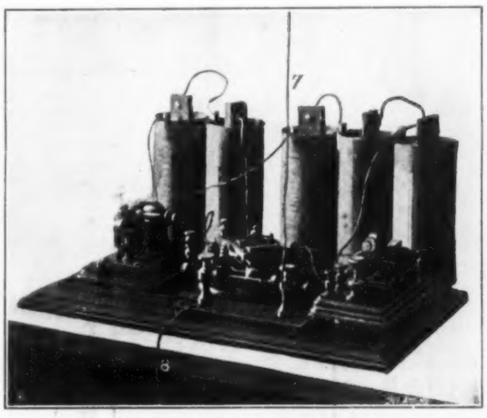


FIG. 3.—SET OF RECEIVING APPARATUS FOR WIRELESS TELEGRAPH.

then connected to the oscillators—one on either side, as shown in Fig. 2, 6,6. The aerial and earth wires may be soldered to a bit of spiral spring, as this forms a good connection and one that can be readily removed if necessary. The transmitter may be set on a table or other stationary place, but for convenience it is well to have the coil and key mounted on a separate base.

To the receiving device there are more parts than to the transmitter, and to simply gaze upon the cut, Fig. 3, it would be almost impossible to obtain a correct idea of the connections. To the layman the most mysterious part of the whole system of wireless telegraphy is the most simple and the easiest understood. I refer to the coherer. Fig. 4 is a diagrammatic view of an experimental coherer, one that is suitable for the set in hand, for it is inexpensive, easy of adjustment and quite sensitive. A coherer, reduced to its simplest parts, consists of two pieces of wire, brass or German silver, 1-16th inch in diameter, forced into a piece of glass tubing, with some silver and nickel filings between the ends of the wire at the point, 7.

The brass standards shown, 1, in Fig. 4, together with the set screws and springs, are merely adjuncts attached to the coherer wires to obtain the proper adjustment and to then retain it. The filings may be made from a nickel five-cent piece and a silver dime, using a coarse file. The amount of filings to be used in the coherer can be roughly estimated by having the bore of the tube 1-16th of an inch in diameter, and after one wire plug has been inserted, pour in enough of the filings to have a length of 1-16th inch. Before describing the function of the coherer, it will be well to illustrate the connection of the relay, tapper, sounder and coherer, and batteries. As shown in Fig. 3, the tapper—the central instrument back of the coherer—is improvised from an old electric bell, the gong being discarded. The relay, on the right, should be wound to high resistance, about 100 ohms. It is listed as a "pony relay," and, like all other parts of the apparatus except the coherer, it may be purchased of any dealer in electrical supplies. The sounder, on the left, is an ordinary Morse sounder of 4 ohms resistance. The tapper magnets should be wound to 4 ohms. All should now be mounted on a base 10 by 16 inches and connected up as the diagram, Fig. 5, illustrates; that is, the terminals of the coherer are connected in series with two dry cells, 2, and the relay, 3. From the relay a second circuit, also in series, leads to the tapper, 6, thence to a battery of three dry cells, 5, and on to the sounder, 4, and finally back to the relay, 3. This much for the two electric circuits. The puzzling part to the novice in wireless telegraphy lies in the wires, 7 and 8, branching from the coherer. These have nothing to do with the local battery circuits, but lead respectively up a mast equal in height to the one at the transmitting end and down in the ground, as before described. These are likewise provided with copper plates. As shown in the engraving, Fig. 3, the connections are all made directly between the relay, coherer, sounder, tapper, and batteries for the very sensible reason that they are connected together with a deal less trouble than by the somewhat neater method of wiring under the baseboard. This, however, is a matter of time, taste and skill.

Now let us see what the functions of each of the appliances constituting the receiver are, their relation to each other, and finally, as a whole, to the transmitter a mile away. To properly adjust the receiver to the transmitter it is well to have both in the same room—though not connected—and then test them out. The relation of the coherer to the relay and battery circuit may be likened to that of a push-button, the bell and its battery. Coherer and push-button normally represent the circuit open. When one pushes the button, the circuit is closed and the bell rings; when the Hertzian waves sent out by the distant transmitting coil reach the coherer, the particles of metal filings cohere—draw closer together—thus closing the circuit, and the relay draws its armature to its magnets, which closes the second circuit, and then the tapper and sounder become operative.

The purpose of the tapper is to decohere the filings after they are affected by the etheric waves each time, otherwise no new waves would manifest themselves. The relay is necessary, since the maximum and minimum conductivity of the coherer, when normal and when subjected to the action of the waves, is not widely divergent, and therefore an appliance far more sensitive than an ordinary telegraphic sounder is needed; this is provided by a relay, which, while being much more sensitive, has the added advantage of operating a delicately-poised lever or armature instead of the heavy one used on the sounder. Signals can be read from the tapper alone, but to produce dots and dashes—the regular Morse code—a sounder is essential.

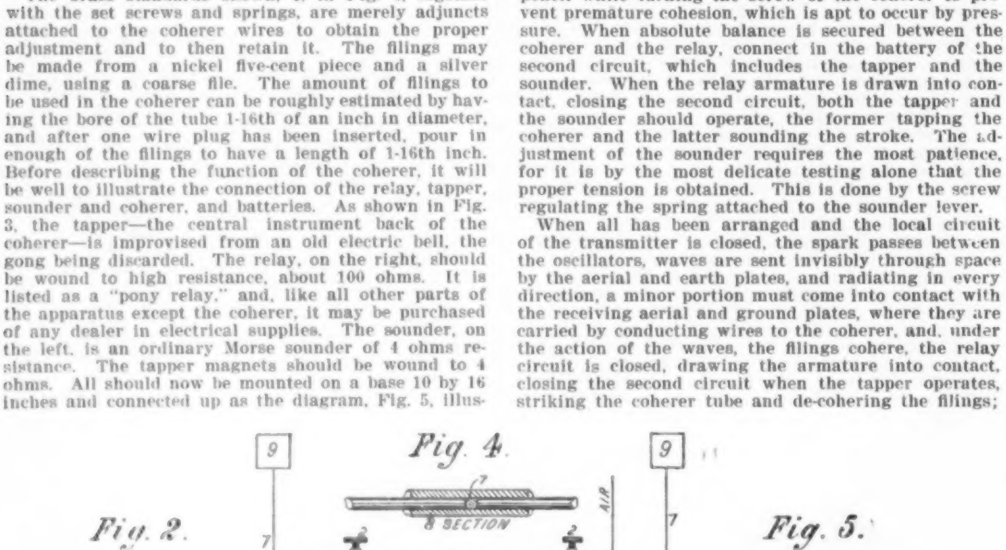
The adjustment of the coherer and its relation to the relay is not as difficult as the final adjustment of the sounder and tapper, but if the following rules are adhered to carefully, the result will be a successful receiver.

First arrange the adjusting screws of the relay armature so that it will have a free play of only 1-32d of an inch, when the armature is drawn into contact with the second circuit connection, just clearing the polar projections of the magnets; have the tension of the spring so that it will have only "pull" enough to draw back the armature when there is no current flowing through the relay coils. Now connect the two dry cells in series with the coherer, Fig. 5. Unscrew one of the top set-screws, 2, Fig. 4, and then screw up the inner screw, 3, until the current begins to flow through the circuit and pulls the armature of the relay to the magnets. Tap the coherer with a pencil while turning the screw of the coherer to prevent premature cohesion, which is apt to occur by pressure. When absolute balance is secured between the coherer and the relay, connect in the battery of the second circuit, which includes the tapper and the sounder. When the relay armature is drawn into contact, closing the second circuit, both the tapper and the sounder should operate, the former tapping the coherer and the latter sounding the stroke. The adjustment of the sounder requires the most patience, for it is by the most delicate testing alone that the proper tension is obtained. This is done by the screw regulating the spring attached to the sounder lever.

When all has been arranged and the local circuit of the transmitter is closed, the spark passes between the oscillators, waves are sent invisibly through space by the aerial and earth plates, and radiating in every direction, a minor portion must come into contact with the receiving aerial and ground plates, where they are carried by conducting wires to the coherer, and, under the action of the waves, the filings cohere, the relay circuit is closed, drawing the armature into contact, closing the second circuit when the tapper operates, striking the coherer tube and de-cohering the filings; at the same time the lever of the sounder is pulled down, and, by the law of inertia, it will continue to remain down, if a succession of waves are being sent by the transmitter, assuming the key is being held down, producing a dash, notwithstanding the tapper keeps busily at work decohering in response to the continuously closing circuit caused by the waves; but the sounder—sluggish in its action—when once drawn down, will remain so until the last wave is received and the tapper decoheres for the last time, finally breaking the second circuit for a sufficient length of time to permit the heavy lever to regain its normal position.

All these various actions require a specific time in which to operate, and so the transmitting key must be operated very slowly, each dot and dash being given a sufficient length of time for the passage of a good spark. With the Marconi, Slaby, Guarini and all other systems of wireless telegraphy now in use, only twelve to fifteen words per minute can be sent. It is also well to remember that the higher the wires leading up the mast are, the further the messages will carry. Wireless transmission over water can be carried to about ten times as great a distance as over land.

Wireless telegraphy is very much like photography and everything else worth knowing. To know it well requires care, patience and practice, and the more one keeps everlastingly at it, the greater the results will be.



DIAGRAMS OF WIRELESS TELEGRAPHIC APPARATUS.

CONTEMPORARY ELECTRICAL SCIENCE.*

Change in Dimensions due to Magnetization.—E. Rhoads investigates the relation between the changes of length and of width in a long thin specimen of iron due to its magnetization. So far, only Bidwell and Nagaoka and Honda have dealt with the case of uniform magnetization. Their results are opposite in character, Bidwell obtaining a diminution of volume, at least in low fields, while the Japanese physicists obtain an increase in all fields. In the results of neither does any simple relation between the longitudinal and transverse changes appear. The author's specimens consisted of narrow strips of thin tinned sheet iron 21 cm. long, only 7 cm. of which was used in the measurements, so as to insure uniform magnetization. The expansion was measured with a tilting mirror and a lever arrangement similar to that used in the compensating pendulum. The curves obtained show that the specimen which is lengthening as the field is being increased continues to lengthen when the field is gradually withdrawn, then a maximum length is reached and shortening begins. A maximum length is usually reached in fields of some 30 units. The author has not yet obtained reliable data for the change of width.—E. Rhoads, Phil. Mag., November, 1901.

Chemical Action of Radium Rays.—Berthelot has discovered some interesting changes produced by radium rays. To guard against secondary effects, he had to keep the radium preparation inclosed in a sealed tube, and it is possible that a good deal of the effect may have thus been lost. But even through one or two and sometimes three glass walls the chemical actions were quite unmistakable. The first reaction described is the decomposition of powdered iodic acid, I_2O_5, into oxygen and iodine after being placed next the radium tube in the dark for nine days. In this reaction, the rays not only determine the action, but furnish the necessary energy. Another endothermic reaction, which is common to sunlight and to radium rays, is the decomposition of nitric acid. The rays, on the other hand, are not capable of precipitating sulphur from its solution in carbon bisulphide, as is done by sunlight. Acetylene, again, which undergoes polymerization under the electric brush discharge, is insensible to both sunlight and radium rays. An extraordinary phenomenon witnessed was the double coloration of the glass tube, which was blackened in some places by the reduction of lead, and colored violet in others by the oxidation of manganese. The author suggests some kind of ionization of the glass under the rays as an explanation.—Berthelot, Comptes Rendus, October 28, 1901.

Electric Waves.—A pretty full discussion of the theory of the propagation of electric waves along wires is contributed by M. Abraham. He distinguishes two cases, in the first of which the return current is a pure conduction current, and in the second of which displacement currents also come into action. Ordinary telegraphy and telephony belong to the first category, and space telegraphy to the second. In oscillations of the Hertzian order it depends upon the distance between parallel conductors whether dielectric return currents come into play. The author discusses the relation between the conditions of propagation and the electromagnetic energy of the waves. He proves, among other theorems, that in stationary electromagnetic oscillations in a field bordered partly by perfect reflecting surfaces, while through the remainder plane homogeneous waves import and export energy, the mean magnetic energy equals the mean electrical energy. In the case of wire waves, the effective and apparent internal inductances are identical, and when the return circuit is metallic, and therefore the values of the apparent capacity and apparent external inductance are real, these values are identical with the values of the effective capacity and the effective external inductance derived from the field energy.—M. Abraham, Ann. der Physik, No. 10, 1901.

Structure and Capacity of Dielectrics.—M. von Hoor has made some 8,000 measurements of the inductivity of paraffin, gutta percha, glass, mica and impregnated fiber dielectrics. As regards the latter, they were found to be subject to a great variety of disturbing influences, such as air bubbles, faulty impregnation owing to viscosity, low temperature or impurity of the impregnating substance, and traces of acids or chlorine. Perfectly pure linen, jute, or manila fiber substances, impregnated with liquid or well-melted pure paraffins or resins showed a very uniform behavior, and their specific resistance was found to be very high. In freshly-prepared paraffin condensers there is a slow settlement, which lasts several weeks, and is the slower the higher the melting point of the paraffin or the lower the temperature at which the condenser is maintained. Condensers made of alternate films of glass and silver fused together show a rather high conductivity, but also a great capacity. Condensers made of layers of mica stuck together, like the so-called micanite and megohmite, show an almost complete independence of the capacity from the voltage to which they are exposed. It may be generally stated that great viscosity is shown by dielectrics composed of various successive layers. The thickness of the layers is also of great moment. As the thickness increases, the hysteresis per cycle and per cubic centimeter also increases.—M. von Hoor, Elektrotechn. Zeitschr., 36 and 38, 1901.

* Compiled by E. E. Fournier d'Albe in The Electrician.

EFFECT OF ALTITUDE ON THE SYSTEM.

The London Lancet states that at a meeting of the Paris Academy of Sciences, M. Gaule laid before the members the results of some researches which had been undertaken by himself with a view to ascertain whether the results of a balloon ascent were comparable with those obtained at a high altitude on land—e. g., at the top of a mountain. The most notable of these is a marked augmentation in the number of red corpuscles. Viaux and sundry observers who followed him have ascertained that at a high altitude there is a great increase in the number of red corpuscles. Thus in the Cordilleras at a height of 4,000 meters, Viaux found 8,000,000 red corpuscles per cubic millimeter. M. Gaule wished to see whether in a balloon ascent, where ascension is very rapid and entails no muscular exertion, a similar phenomenon would occur. He made two investigations at heights of 4,200 and 4,700 meters and found in himself 8,000,000 red corpuscles per cubic millimeter. Further, M. Gaule at a height of over 4,000 meters made some blood-films stained after Ehrlich's method with eosin and hæmatoxylin. He found numerous red corpuscles which showed a nucleus colored blue by the Hæmatoxylin. This nucleus was in many instances segmenting, and also groups of three or four corpuscles were seen as if they had undergone subdivisions. Similar preparations made before the ascent showed no such appearances. M. Gaule therefore considers that at high altitudes there is an actual formation of red corpuscles and that this takes place with great rapidity. At the following meeting M. Tissot and M. Hallion gave an account of researches on

a somewhat analogous subject. On November 21 they undertook some researches at various altitudes into the physics and chemistry of the respiration. Experiments were made at the following heights: 1,350 meters, 2,600 meters, and 4,450 meters in the case of M. Tissot, and at 1,700 meters and 3,500 meters in the case of M. Haillon. The chemical phenomena of the respiration did not vary appreciably at these different altitudes. The respiratory rhythm, however, was greatly modified. Although the total quantity of air entering the lungs was less the number of respirations was not sensibly altered. It would thus appear that at high altitudes the air is purer and more completely used.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Barber Shops and Shaving Soap in the Netherlands.—The average Hollander is shaved from two to six times a week by a barber, either at the barber shop or shaving parlor or at his private residence.

The barber shops in the Netherlands, though tolerably well appointed, do not compare with those in America. Our reversible barber chairs are practically unknown, and the round-backed chair, with simple sliding head rest, is still in general use. About the proper application of bay rum and sea foam very little is known, though shampoos are getting to be the fashion. French perfumed hair waters and "Brillantine" are much used, and the fashionable barber will generally ask a customer, after the latter has washed the soap off his own face, if he wishes "Vinaigre" on his face before the powder, and his hair done up with "Eau Vegetal" and "Brillantine." Fastidious customers generally keep their own assortment of bottles of hair waters, besides their razors, brushes, combs, and soap, in their private drawer in the shop.

I understand that the barber shops have much improved of late years, and I believe that the Dutch barbers, as a class, are alive to the fact that their methods and the appointments of their parlors can still be improved. Of late, the barbers and hairdressers, and also the employés, have formed an association, by which certain rules regulating the tariff for shaving and hair cutting and the working hours and wages have been established. The present average tariff of a first-class barber and hairdresser is 15 Dutch cents (6 American cents) for shaving, 20 Dutch cents (8 American cents) for shaving and hair dressing, and from 25 to 30 Dutch cents (10 to 12 American cents) for hair cutting. Tickets good for ten shaves may be bought for 40 American cents, while one and one-half shaves on such a ticket are charged for shaving and hair dressing. Annual and monthly tickets can also be had. The prices of the annual tickets for shaving, hair dressing, and hair cutting range from 15 to 30 florins ($6 to $12), according to the number of times a customer is shaved during the week. As customers holding tickets are supposed to furnish their own shaving material, besides the necessary bottles of hair waters, the cost of shaving and hair dressing in the fashionable parlor is not as cheap as the foregoing figures would indicate. As a matter of fact, the average fashionable barber makes more by the sale of materials and hair waters than he does by shaving and hair dressing.

WAGES OF BARBERS.

The wages of a barber's assistant range from 6 to 14 florins ($2.40 to $5.60) and those of an assistant understanding hair dressing from 14 to 16 florins ($5.60 to $6.40) a week, besides a percentage on sales and tips. The barbers belonging to the "Dutch Barbers and Hairdressers' Association" keep their shops and parlors open from 8 A. M. to 9 P. M. On Sundays, some of the shops are open from 9 till 12 in the morning, while others are closed all day.

SHAVING SOAP.

The soaps used by the barbers and by the few that shave themselves are principally cream and powder of French manufacture. In the cheaper barber shops, where the workman gets his shave and where a lower tariff prevails (shaving 2 to 2½ American cents and hair cutting from 4 to 6 American cents), cakes of soap of Dutch manufacture are used.

The wholesale price of the French perfumed cream shaving soap is, for twelve porcelain boxes, each containing a little over an ounce of soap, from 6 to 12 florins ($2.40 to $4.80); and for a dozen boxes each containing a little over half an ounce, from 4 to 6 florins ($1.60 to $2.40). The price of the powder is from $1.20 to $1.80 per dozen boxes. The shaving soap in cakes of Dutch manufacture sells from 9 to 12 American cents per pound.

The retail prices for the porcelain boxes of perfumed shaving cream are: Full boxes, 30 to 60 American cents; half boxes, 20 to 30 American cents. Shaving soap is sold at 4 American cents per cake. Persons shaving themselves buy their soap in stores or barber shops at retail prices.

The barbers generally buy their soaps either direct from the manufacturers in France or through their agents in Holland and Belgium. Traveling men and agents of the manufacturers regularly call at the principal barber shops to solicit orders and furnish advertising matter.

DUTIES ON SOAP.

The import duties on soaps entering the Netherlands are as follows, per 100 kilogrammes (220.46 pounds):

	Florins.	
Perfumed and transparent soaps	4 =	$1.60
Other hard soaps	2 =	.80
Other soft soaps	1 =	.40
Creoline soaps	2 =	.80
Dry soap, in packages	5 per cent ad valorem.	

Soap powder, not perfumed, pays the same duty as "other hard soaps."

HOW TO INTRODUCE AMERICAN SOAPS.

The best means of advertising shaving soaps is to furnish the fashionable shaving parlors with attractive advertising signs to adorn the walls and show windows. These, when placed properly, always attract attention. Another good way is to advertise in the Barbiers en Kapperscourant (Barbers and Hairdressers' Journal), the periodical of the Dutch Barbers and Hairdressers' Association.

Generally speaking, American articles are favorably looked upon here, and the excellent qualities of our manufactures are duly appreciated.

No statistics exist as to the quantity of shaving soap used or imported annually; the amount must, however, be considerable, considering that this country is thickly populated.—S. Listoe, Consul at Rotterdam.

American Trade Opportunities in France.—There are some American utilities with which the French are unacquainted. Among those that have particularly attracted my attention are:

Heating Apparatus.—France is a country in which the most astonishing variations of temperature occur, and its inhabitants pay yearly nearly 1,000,000,000 francs ($193,000,000) for various methods of warming themselves. On coal, about 540,000,000 francs ($104,000,000) are spent; on wood, about 360,000,000 francs ($69,480,000); and the rest goes for petroleum, methylated spirit, and gas. Wood, which before the introduction of coal was the staple fuel, is now the luxury of the rich. In many of the cities, gas has ousted charcoal from the kitchen; one reason being that, according to French taste, there is nothing like gas for certain operations, such as grilling a steak, because the heat can be applied from above.

There is not in this city (Rouen) a hot-water or steam radiator. Heat is furnished by coal stoves, grates, and occasionally furnaces. All the principal offices here have stoves, and the proprietors do not seem to know or care for anything better. Some of the dealers in stoves, stove appliances, heating apparatus, etc., in Rouen are:

Andréotta, 1 place Purcelle.
Defosse fils, 4-6 rue Basnage.
Drély Jeune, 10 rue Amitié.
E. Langlois, 144 rue E.-de-Robec.
Hamel, 65 rue Amiens.
J. Lani, 34-36 rue Hopital.
Vve. Tardivet, 15 rue Panneret.

Lighting Apparatus.—Electricity, gas, petroleum, and candles are the chief sources of light; candles are most common, and are exclusively used throughout the country districts of Normandy by rich and poor alike. In the advertisements of two of the best hotels in this city, emphasis is laid upon the fact that guests will have the conveniences of electricity. In the business houses of Rouen, gas is principally used, electricity but very slowly superseding it. A good lamp—one that gives a bright light and uses little oil—would, I believe, meet with success. The French lamp is at best but a poor affair, generally with a wick arranged to give a circular flame, and with a tall chimney. It burns considerable oil and emits a feeble light, while the price is from 50 to 100 per cent higher than the same article would cost in New York. I have never seen anything like the Rochester burner here, or any apparatus to enlarge the flame.

The tariff on lamps per 220 pounds is as follows:

Porcelain, brass, iron, and glass lamps.	$11.58
Metal lamps:	
Nickel-plated	28.95
Gold or silver plated	48.25

The tariff for mountings, in case of detachable lamps, is $1.54 per 220 pounds; but the bowl and permanently connected parts pay as above. While these figures are official, I would not advise American exporters to depend upon them. To know accurately, it is always better to submit a sample. The principal merchants in Rouen who deal exclusively in lamps are:

R. Cardon, 66 rue Jeanne d'Arc.
Leon Gruson et Cie, 49 rue Moliere.
Lelandais, 84 rue Jeanne d'Arc.
Malcape, 49 rue Ours.
Wittorski-Hachette, 40 rue Jeanne d'Arc.

Barber Chairs.—There is in this district an opportunity for the introduction of barber chairs. The best barber shops in Rouen, a city of over 150,000 inhabitants, have straight-backed, cane-seated armchairs, with a crude detachable head rest, all of which could be bought anywhere in the United States for $2.

The patronage of barber shops in Normandy is large; a shave can be had for 5 or 7 cents.

As a general rule, the hairdresser here takes great pride in his work; he likes keen razors, clean mirrors, and an attractive shop, and it would be strange if the luxurious American barber chair did not appeal to him.

While barber chairs are not specially mentioned in the tariff schedule, they would very likely be classed under one of the following heads (per 220 pounds):

Furniture of bent wood:	
Plain	$3.09
Ornamented	11.19
Furniture other than that of bent wood:	
Chairs of common wood, not carved nor inlaid or ornamented with copper	2.12
Chairs of cabinetmaker's wood, not carved nor inlaid or ornamented with copper	3.86
Chairs of any sort of wood, covered, inlaid, or ornamented with copper	5.79

To know accurately, however, it is safer always to submit a sample.

The addresses of some of the largest barber shops in Rouen are as follows:

M. Aché, 29 rue Grand-Pont.
M. A. Amel, 163 rue Beauvoisine.
M. Delacroix, 97 rue Jeanne d'Arc.
M. Daleinne, 74 rue Jeanne d'Arc.
MM. Desleux, 21 rue Jeanne d'Arc.
M. Martin, 13 rue Grand-Pont.
M. Nicolle, 13 quai du Havre.
M. Fleury, 38 quai de Paris.
M. Hebert, 78 rue de la République.
M. Laquèvre, 74 rue de la République.
M. Lemercier, 47 rue Jeanne d'Arc.

Cash Registers.—So far as I have seen, there is not a single cash register in Rouen. Every shop or store has its cashier, usually a member of the proprietor's family—the wife, or daughter, or sister—who does all her sewing at the desk where the purchases are paid for, the clerk never being allowed to handle any money. This old-fashioned and supposedly economical custom would be hard to overcome, and those who try the introduction of registers need not look for quick results, unless they are shown to aid rather than usurp the work of the cashier. If a market were once created, it would undoubtedly yield large returns.

It would seem that the best field for trial is offered by the numerous cafés, where sales are constant from morning until late at night.—Thornwell Haynes, Consul at Rouen.

American Apples in Austria.—In answer to inquiries from a Chicago firm, Consul-General Hurst writes from Vienna, November 8, 1901:

There is an excellent prospect for selling American apples in Austria. In general, yellow and light-colored apples are considered the choicest here, although any apples of good size and flavor find a ready market. It is only when the Austrian, or, more particularly, the Tyrolese crop fails that apples are imported. The harvest from Tyrol is not up to the average this year, and apples have been imported from Hungary and elsewhere. There is no use for small apples, since, even if the Austrian apple crop proves poor, there is always plenty of this sort harvested in neighboring countries. The usual wholesale price here for good apples is 36 crowns ($7.31 in gold) for 220 pounds. A large barrel of apples here weighs from 154 to 157 pounds; the apples themselves, from 132 to 135 pounds.

There is no duty on apples. The best way to pack them is to place paper and excelsior between layers of apples, in order that they may not be bruised. Special care should be taken that the apples are not infested with San José scale, because, on arrival in port, several apples from each barrel are microscopically examined by experts, and if one of the insects is discovered the entire shipment is debarred entrance. Apples should be sent via Trieste, as the freight from there is somewhat less per car than from Hamburg. The middlemen in Hamburg, it is said, charge very high prices, compared with those they pay the American seller.

Consular Plan in Export Trade.—A few weeks ago, a young American business man called at the consulate to tell me that one American firm, at least, had followed my plan in export trade and had been wonderfully successful in doing so. I understand that my caller had read and approved of those portions of my trade reports where, in entire agreement with all of my consular colleagues, I have urged that American manufacturers study and regard not only the needs, but even the whims, of foreign consumers; and that, having ample capital and a good working partner, he had put the idea into successful operation. The firm has about eight agencies. In each contract there is a clause binding the manufacturer to make and pack and ship any article in exactly the way the London agent specifies, and no agency is taken from a manufacturer who will not so bind himself in legal form, and the manufacturer is given to understand that this is the most important clause in the contract and that his personal views on foreign markets are not wanted. As an example, my caller told me that last year he sold in great numbers an American-made bicycle built almost on British lines, with double-tube tire and metal rims, and that for the coming seasin his bicycles will have exact reproductions of standard British bicycle fittings and Whitworth threads.—Marshal Halstead, Consul at Birmingham.

Gold in Madagascar.—News recently from Madagascar indicates that the island is about to justify the hopes which have been entertained by numerous engineers as regards mineral resources.

Circumscribed auriferous regions, said to be very rich in the precious metal, are being worked on the eastern slopes and near the port of Manangary. The gold is in the form of small nuggets or of dust, taken from the alluvial deposit carried down by two streams from a neighboring mountain. It is supposed that the metal is derived from the disintegration of rocks situated at the origin of these streams, at a point not yet determined, and that there will be found the principal lode.

The washing of the alluvial deposit is effected in a kind of large wooden dish, in which the auriferous earth is placed—a very primitive method, but for the present sufficiently remunerative.

The work is mostly done by the natives under the direction of Europeans, as they alone can stand the rays of a tropical sun, as well as remain in the water for hours each day.

Already, two prospectors have discovered blocks of quartz which they estimate as capable of furnishing 4 ounces to the ton. Traces of the metal have been found more or less over the whole island.—Hilary S. Brunot, Consul at St. Etienne.

Demand for American Gas Coal in Austria.—There is an increasing demand in Austria for a high-grade gas coal. Strange as it may seem, the production of artificial gas is advancing in this country. This is due to two different causes: First, the Auer incandescent gas-burner, an Austrian invention, which is in general use here, has greatly increased the efficiency of gaslight, and in a measure, re-established the popularity of gas as an illuminant; second, the relentless war which is being waged against the smoke nuisance in many cities has led a large portion of the smaller establishments to employ gas as their motive power. The increased consumption of gas has made the erection of many new works necessary, especially in the larger cities, and has also greatly quickened the interest of gas experts in improved processes of production, as well as in new and more productive kinds of raw material.

In the past the bulk of the gas coal consumed in southern Austria has been imported from England. The present price of this coal f. o. b. Trieste is about 19 shillings ($4.62) per ton, and the average quantity of gas produced from it is from 29 to 30 cubic meters per quintal, or about 10,500 cubic feet per ton. The total quantity of gas coal consumed in this consular district is probably about 300,000 tons per annum.

In a recent number of a German gas journal the statement appeared that at a test made in London an American coal had yielded 15,900 cubic feet of gas per ton. Such a coal, if it really exists, would be worth here not less than $6 a ton.

Mr. Emil von Malberg, manager of the Eggenburg Gas Works, at Graz (250 miles north of Trieste), recently applied to me for addresses of American exporters of gas coal, and, referring to the alleged London test, said: "The statement is astounding. If it be true, it would pay even in Graz to use American coal."

I should be pleased to receive from our coal producers, for distribution among interested parties in my district, analyses of their coals, as well as statements of well-authenticated gas tests, where such tests have been made.

That with properly directed efforts a good market can be established here for superior grades of American gas coal I have not the least doubt.—Frederick W. Hossfeld, Consul at Trieste.

Petroleum in Greece.—The fact has just been made public that the English Syndicate which has been endeavoring for some time past to secure the right to develop the supposed oil territory in the Island of Zante, has renewed its negotiations under the new government. During the previous administration practically all the arrangements had been completed, and awaited only the ratification of the Chamber of Deputies to go into effect. The recent troubles, however (arising over the proposed translation of the gospels into common Greek, and culminating in the resignation of the entire ministry), shelved the matter for the time being. It is made public now that the tedious process of securing the new ministerial sanction is again under way, and that the agreement is about to be signed.

What this may mean to Greece depends entirely upon whether petroleum is discovered or not. The field is a very old one, dating back of the time of Herodotus, by whom mention of it was made under the term "naphtha," and that part of the island is known as the Deme Naphthalion. The promising section is the southern part, the low, swampy region where the bogs and marshes exude a substance which has every quality of crude petroleum, and have marked resemblances to the great oil fields of Russia, near the Black Sea. Peasants have been known to set fire to this naphtha, and it has burned continuously for months. Repeated, but unsuccessful, attempts have been made to find oil in paying quantities, but always by companies or individuals without sufficient means and experience. The English Syndicate, if successful in satisfying the demands of the Greek government, will spend a great deal of money in developing the territory.—F. W. Jackson, Consul at Patras.

New Danish Steamship.—The United Steamship Company (Copenhagen to New York) will put on its line in a few months a new steamer of 16,000 tons displacement, named "Oscar the Second," after the King of Sweden. She was launched yesterday from the yards of Alexander Stephen & Son, on the Clyde. Her length is 515 feet; breadth, 58 feet; and height to the upper deck, 42 feet. She will have a carrying capacity of 6,500 tons. This will make her the largest ship in commerce plying to the Baltic.

She is a double-screw steamship, with two triple-expansion engines, each with three cylinders and condensers, which together give 8,000 horse power. She has three steel decks running the whole length of the ship, and the hold is divided into ten water-tight compartments.

She has ample accommodations for 81 first-class, 60 second-class, and 800 third-class passengers. The ship throughout will be supplied with modern appliances.—J. C. Freeman, Consul at Copenhagen.

Samples of Eastern Goods for Germany.—Under date of December 9, 1901, Consul-General Guenther, of Frankfort, says:

German papers report that the committee of German trade experts sent to eastern Asia has concluded its work. The samples of goods brought from China and Japan have been distributed among different corporations. The textile samples have been given to the chamber of commerce at Crefeld and the samples of leather and leather goods to the German experimental station for leather industry at Freiberg, Saxony.

German Beet-Leaf Drying Plant.—Under date of December 9, 1901, Consul Baehr, of Magdeburg, writes:

A plant for drying the leaves of the sugar beet has been erected near Göttingen. The factory began to be worked at the opening of the beet season and is proving very satisfactory. The fodder obtained is excellent, contains much nutritive property, is very dry, and is eaten readily by cattle. It has also a pleasant smell, similar to that of fresh sweetbread. The Government and agricultural authorities are taking much interest in this invention, which will notably increase the profits of the beet industry.

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